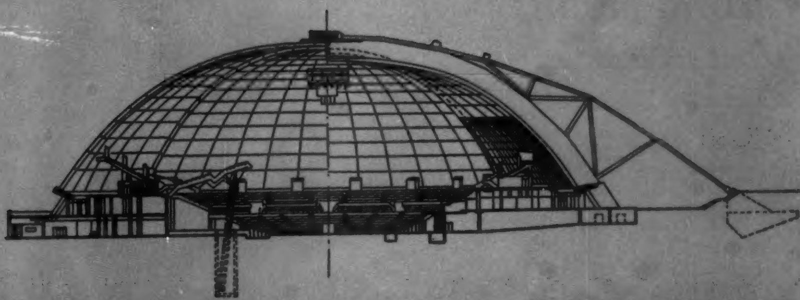
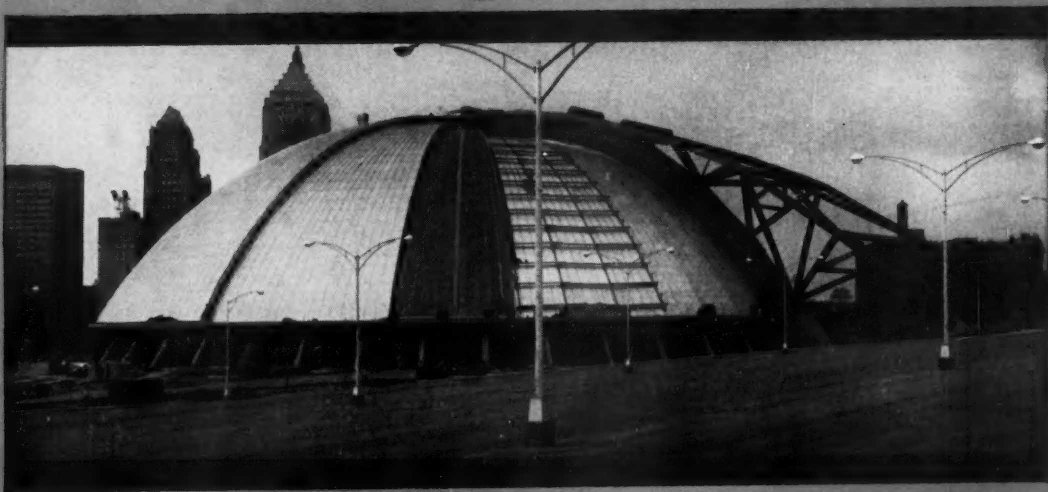
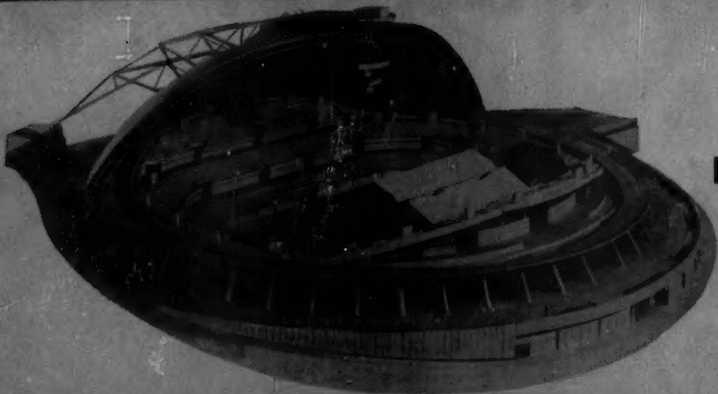
CIVIL ENGINEERING

THE MAGAZINE OF ENGINEERED CONSTRUCTION • JUNE 1961







Pittsburgh's retractable-dome auditorium

TABLE OF CONTENTS PAGE 3

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

Civil Engineering, June 1961, Vol. 31, No. 5 • Published monthly by the American Society of Civil Engineers. Publication office Concord, New Hampshire. (Second class postage paid at Concord, New Hampshire.)

CIVIL ENGINEERING

Official monthly publication of ASCE

EDITORIAL STAFF

Editor • Hal W. Hunt
Associate Editor • Frank J. Schneller, Jr.
Associate Editor • Ruth G. Campbell
News Editor • Mary E. Jessup
Washington • E. E. Halmos, Jr.
Art and Production • Dick DiMaggio
Drafting • Frank J. Loeffler

Advertising Manager • James T. Norton
Asst. Adv. Manager • Robert S. Cypher
Adv. Prod. Manager • Jerry Nussbaum

Other advertising representatives are listed on "Index to Advertisers" page

The Society is not responsible for any statements made or opinions expressed in its publications.

SUBSCRIPTION RATES: 50 cents a copy; $5.00 a year in advance; $4.00 to members and libraries; $2.50 to Student Chapter members. Postage to Canada, 75 cents, and to other foreign countries, $1.50 additional. Send to:

CIVIL ENGINEERING
33 West 39th St., New York 18, N. Y.

REPRINTS may be made by giving full credit to the author, copyright credit to *Civil Engineering*, and date of original publication.

Member Audit Bureau of Circulations

53,900 copies of this issue printed

CIVIL ENGINEERING

JUNE 1961

VOL. 31 • NO. 6

THE MAGAZINE OF ENGINEERED CONSTRUCTION

• *ARTICLES*

• *ASCE NEWS*

• *DEPARTMENTS*

The LGP-30 Electronic Computer begins breaking up figure-work bottlenecks the very same day it is delivered.

The Royal Precision LGP-30 is a complete electronic computer system that is delivered to you ready to go to work. It requires no special personnel. It is simple to program and operate . . . an engineer can use it himself. It requires no air-conditioning or expensive site preparation. In fact, it requires *no* site preparation. Just roll the LGP-30 to where it's needed and plug into the nearest convenient 110-volt AC wall outlet. It's mobile, so it goes anywhere... desk-size, so it takes little room.

And, though the LGP-30 can solve routine and theoretical math problems 30x faster than any man—it rents for little more than the salary of an additional engineer. Amazing? No, just well-designed, *advanced*. Let us tell you more about it. Write: Mr. Floyd Ritchie, Royal McBee Corporation, Port Chester, New York.

ROYAL McBEE GENERAL PRECISION

ELECTRONIC DATA PROCESSING SYSTEMS

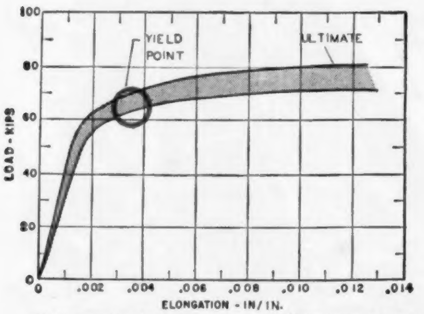
REPORT FROM GARDNER-DENVER

Problems with Torque Control—When tightening bolts by the torque control method, there is no reliable way to tell if they have been tensioned. Torque readings are subject to many forms of interference. To mention a few: irregular threads, burrs, rust and scale, bent washers. Torque readings will vary if threads are lubricated or dry, if washers are soft or hardened.

All these variables offer resistance in the form of friction. Consequently, as a nut is being tightened, the resistance increases until friction becomes great enough to signal the operator or torque control mechanism to stop. Perhaps the bolt has reached its desired clamping force. Perhaps not. The very first obstruction can cause a sharp increase in torque resistance, and the result may be a large variation in true bolt tightness.

New Approach to Bolt Tensioning—However, if you follow the Research Council specifications for tensioning, you're absolutely sure the bolt is tight every time. A new approach to a practical method of obtaining bolt tension was made by Gardner-Denver's research and development engineers. When the new high-strength bolts are tightened to their yield point, the force required is great enough to overcome all frictional interference, and to obviate the effect of frictional variables on final joint tightness.

Gardner-Denver engineers determined that



CALIBRATION CURVES OF 1-INCH DIAMETER HIGH TENSILE BOLTS

if input energy to the wrench could be controlled, the output energy could stress bolts to their yield point (see chart) without approaching ultimate bolt strength. Many impact blows were found to be the answer. These blows, however, must always have the same output force if the bolt is to reach its desired clamping force. Further testing demonstrated that when predetermined bolt tension is reached, the nut will stop turning, even though the wrench continues to impact.

Consistent, Reliable Results—In test after test, Gardner-Denver engineers were amazed at the consistent results achieved with their new Tension Control Wrench. They tightened the same fastener over and over again; the results were the same. They tried other bolts of the same size and achieved consistent tension results. They reset the wrench for bolts of other sizes and materials, and again achieved consistent bolt tensioning every time. This reliability is possible because the wrench can be adjusted to obtain a predetermined tension in any bolt. This clamping force is so great that the variables mentioned above yield until the specified bolt tension is obtained.

Application in the Field—Bolt manufacturers specify minimum proof load and minimum yield. In the field, yield point can be determined by use of a conventional torque wrench or by hand wrenching. It will be indicated by the "steady torque"—the point at which continuous torque (no increase) will continue turning the nut. You find this yield point on a sample bolt—then, using a simple screw adjustment, set the Tension Control Wrench to obtain the same bolt tension. Once set, the wrench will tighten one or thousands of these particular bolts with consistent, accurate results. The Gardner-Denver wrench can quickly be readjusted to handle bolts of other sizes or other materials.

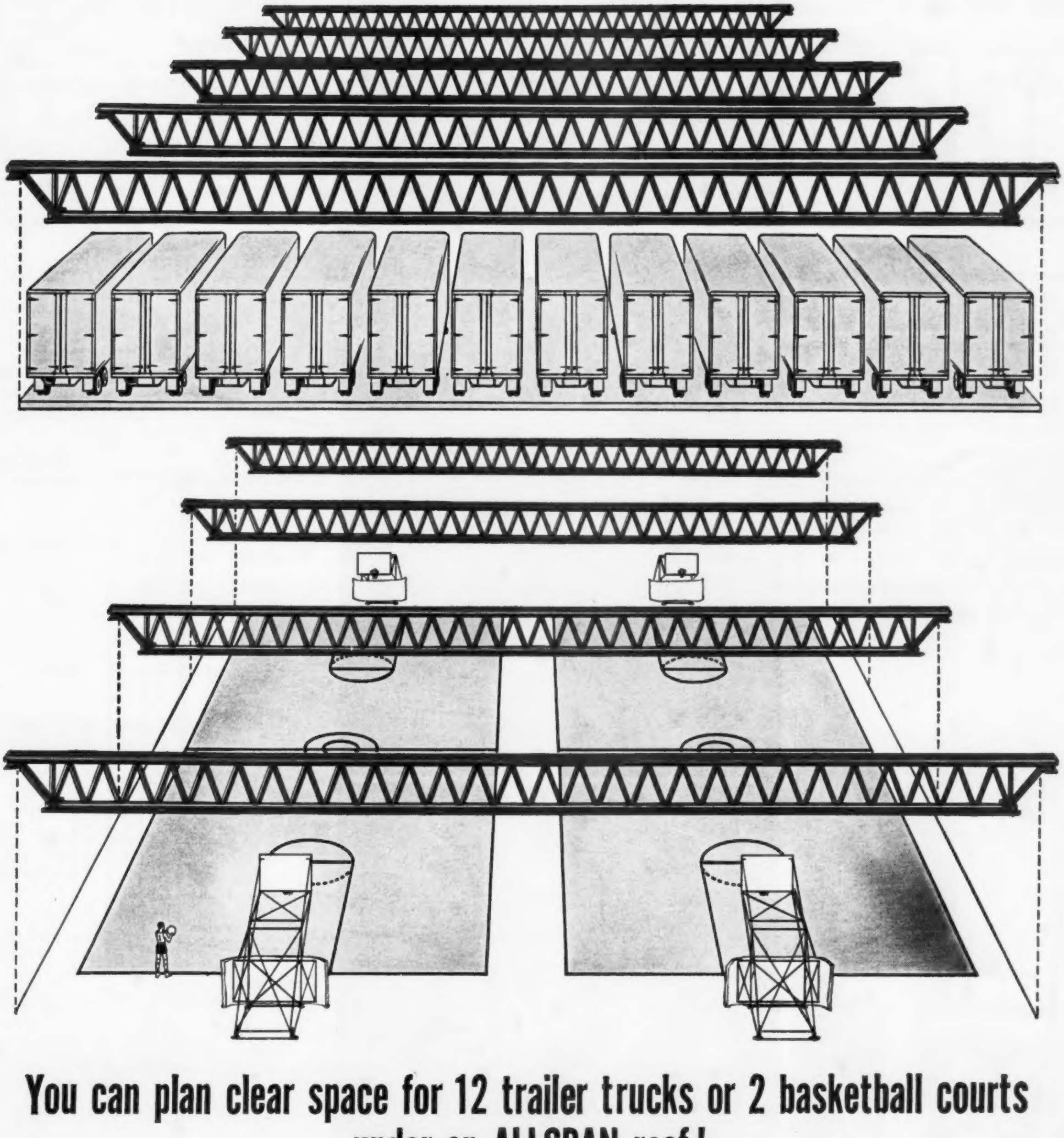
EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

GARDNER - DENVER

Gardner-Denver Company, Quincy, Illinois—Offices in principal U.S., Canadian and Mexican cities. *In Canada:* Gardner-Denver Company (Canada), Ltd., 14 Curity Ave., Toronto 16, Ontario. *International:* Gardner-Denver International Division, 233 Broadway, New York 7, N.Y.

International Offices: Buenos Aires, Argentina; Artarmon, N.S.W. Australia; Brussels, Belgium; Rio de Janeiro, Brazil; Santiago, Chile; Barranquilla, Columbia; Lima, Peru; Ndola, N. Rhodesia; Salisbury, S. Rhodesia; Johannesburg, Transvaal


"Sheks... it's so simple
an' easy we can all go fishin'
the rest of the day"



You can plan clear space for 12 trailer trucks or 2 basketball courts ...under an ALLSPAN roof!

ALLSPANS, up to 120 feet in length, are vital where plans call for maximum unobstructed space. ALLSPANS are the **longest, strongest** open web framing members available. They give you all the design and erection economies of open web construction —**plus** nailability—without excess weight. Frame with ALLSPANS for strength, speed, economy.

Free 28-page construction reference manual
- Dimensions
- Properties
- Load Tables
- Deflections
- Bridging
- Decking, etc.

Please send me your ALLSPAN Design Manual

NAME ______

COMPANY ______

POSITION ______

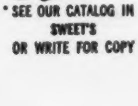
ADDRESS ______

CITY ______ ZONE ______ STATE ______

CE-616

MACOMBER
CANTON 1, OHIO

ALLSPANS • V-LOK • V-PURLINS
BOWSTRING TRUSSES • ROOF DECK • STRUCTURAL STEEL



SEE OUR CATALOG IN SWEET'S OR WRITE FOR COPY

1. Stressing piles for the project at yard in Beloit, Ill.

CLIENT: City of Chicago, Ill. ENGINEER: Department of Public Works, Bureau of Engineering. PRIME CONTRACTOR: Raymond International Incorporated, North American General Contracting Division.

2. Frogmen are called in for lake bottom examination.

3. Rotary drill with 35"-diameter fishtail bit, used for pre-excavation for placement of piles.

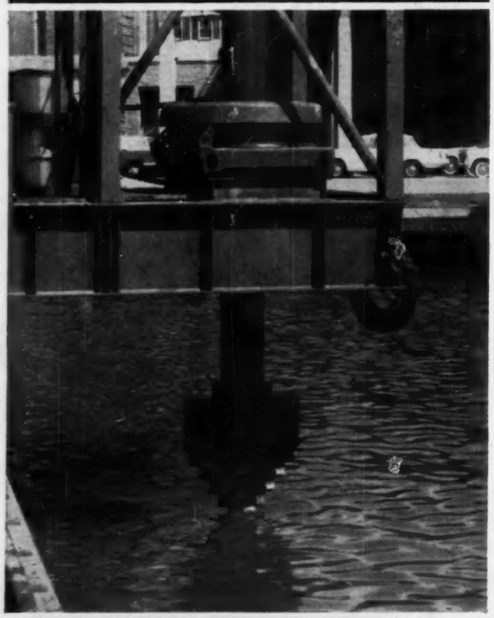
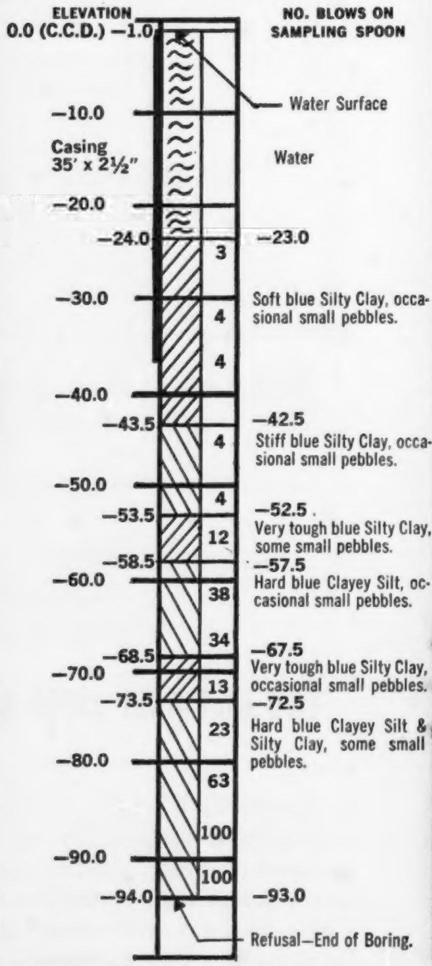
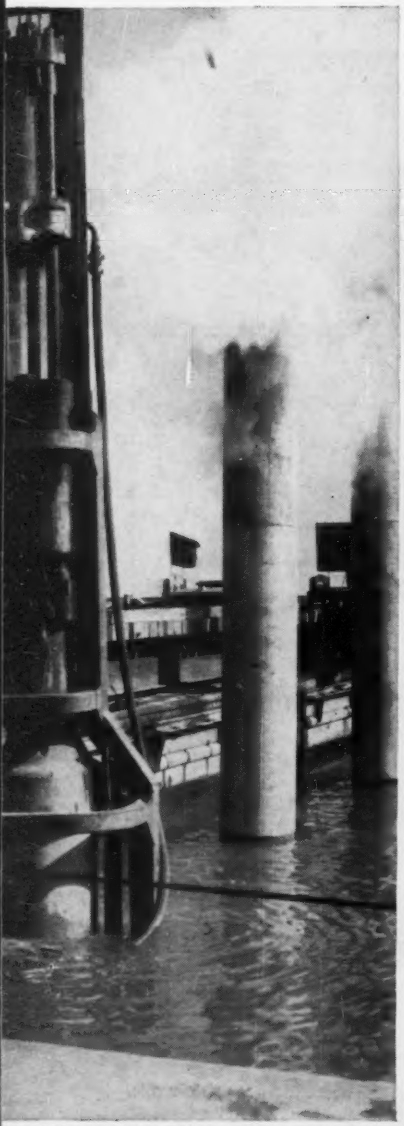
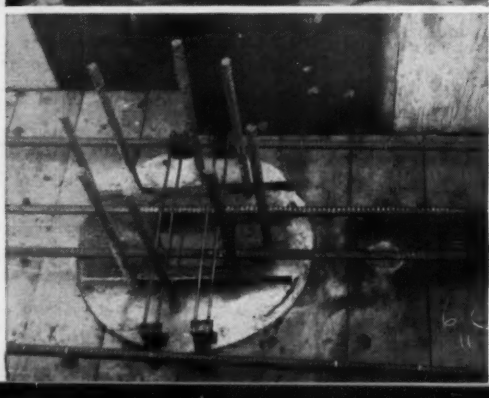


Chart of soil boring indicates many non-supporting layers of silty clay to depth of below lake level of approximately 73.5 feet.





4. After pre-excavating, piles are then driven to prescribed bearing depth.



5. Plugged pile with dowels in place to receive cap and prestressed, precast deck.

6. Caps ready for placement of precast deck.

1

2

6

3

1 FLEX-BEAM gives median strip protection on Interstate 85, Georgia.

2 Near junction of Interstate 35W and Interstate 494 in Minnesota FLEX-BEAM serves as traffic guide as well as protective rail.

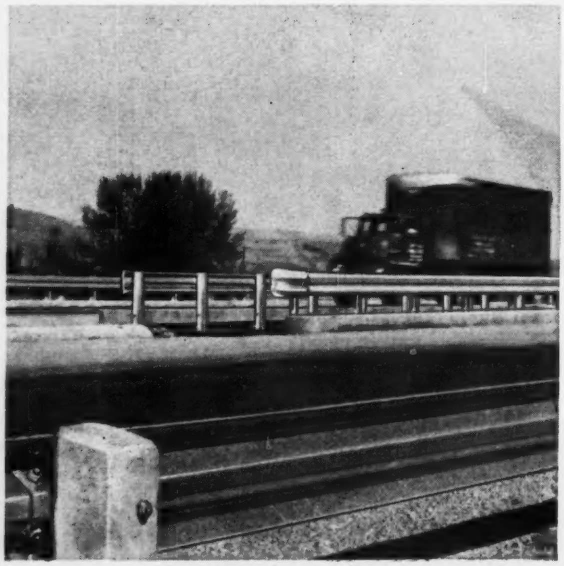
3 Armco FLEX-BEAM on Interstate 20, Texas.

4-5 Bridge railing on Interstate 75, Ohio and Interstate 80, Montana, is Armco FLEX-BEAM.

6 Armco FLEX-BEAM serves as protection around bridge pier on Interstate 75 in Ohio.

4

5



NEWS OF MEMBERS

Three members of the University of Illinois Department of Civil Engineering have been selected as the 1961 winners of the A. Epstein Memorial Award for Faculty Achievement. **Benjamin B. Ewing,** a staff-member since 1958, is currently associate professor of sanitary engineering, having previously served on the faculties of the University of Texas and the University of California. His co-winners, **Mete A. Sozen,** associate professor of civil engineering, and **Houssam M. Karara,** assistant professor of civil engineering, have been on the staff since 1953 and 1957, respectively.

R. Millburn, of the United Kingdom, an urban transportation consultant to the United Nations, is on a three-month assignment in Chile, making a survey of traffic problems and public transport services in the capital city of Santiago.

▼**Frank L. Weaver,** who retired last month after 16 years as chief of the Division of River Basins of the Federal Power Commission is now a consultant in river basin and hydroelectric engineering. Mr. Weaver, a former ASCE Director and Vice President, received a Distinguished Service Award from the FPC when he retired in recognition of his outstanding work in river basin development. His successor, **Stewart P. Crum,** has been a staff-member for nearly 21 years, and head of the Division's Section of Basin and Project Plans for 11 of those years.

Oscar G. Goldman brings to his new position of general manager and chief engineer for the Master Leakfinding Corporation of America more than 47 years of experience with the San Francisco Water Department, where he was most recently superintendent of the City Distribution Division. During this period he developed new methods of performance and analysis for the various problems of water distribution.

Harold D. Hauf, a prominent member of the engineering and architectural profession for more than 34 years, the last seven as dean of the School of Architecture at Rensselaer Polytechnic Institute, Troy, N.Y., has now been named vice president in charge of design and planning for Charles Luckman Associates, of Los Angeles and New York. Earlier in his career he was a member of the Yale faculty, having served there from 1929 to 1949.

Joseph V. B. Wells (left), Delaware River Master and assistant chief of the Water Resources Division of the U.S. Geological Survey receiving the Distinguished Service Award of the Department of the Interior from Assistant Secretary John Kelly. The citation of the award to Mr. Wells recognized his "more than 30 years of outstanding service in the fields of hydraulic engineering and hydrology with the Geological Survey."

(Continued on page 20)

News of Members *(Continued from page 18)*

Carl W. Keuffel, one of the nation's outstanding optical engineers, has retired as president of the Keuffel & Esser Company after serving in that capacity for the past 11 years. Mr. Keuffel, who joined Keuffel & Esser in 1913, is credited with the first successful quantity production in 1916 of high quality optical glass in the United States.

William P. Kimball, Dean of the Thayer School of Engineering at Dartmouth College, has been relieved of his administrative duties to devote full time to developing a new concept in civil engineering education. Known as "environmental engineering" it is proposed to train the prospective engineer intensely in one sector of engineering technology and extensively in the social, economic, political, cultural, and physical conditions in which men live. Since 1945 Dean Kimball has served as head of the engineering school and under his direction a four-year engineering science major and fifth-year curricula in civil, electrical and mechanical engineering was introduced. **Myron Tribus,** professor at the University of California in Los Angeles, has been named to succeed Dean Kimball. In addition to teaching at UCLA, Professor Tribus has done research in several branches of engineering, primarily heat transfer, thermodynamics and fluid mechanics and in 1952 was awarded the Alfred Noble Prize.

Joseph H. Ehlers has resumed his post with the Urban Renewal Administration as assistant commissioner for Technical Standards and Services, after a seven-month assignment in Yemen where he was housing coordinator for the International Cooperation Administration.

Byron J. Prugh, who has been with the Moretrench Corporation for the past 23 years, the last six as director of Research, is now president of Prugh & Associates, Inc., of Tampa, Fla., dealing in soil properties.

Elmer J. Maggi, a consulting engineer of Phoenix, Ariz., for the past two years, has been named "Engineer of the Month" by the Arizona Society of Professional Engineers. Before founding his own firm, Mr. Maggi was with James E. Hastain, with whom he designed sewer and water main projects for the City of Phoenix.

William S. Kerby, whose experience with the consulting firm of Servis, Van Doren & Hazard for the past eleven years has included design work in hydrology, sanitation, highways and various land developments, has established the Community Engineering Company, with offices at 1410 West Fifteenth in Topeka, Kans. The firm will specialize in the design of city facilities and land developments.

George J. Nold, Major General, U.S. Army (retired), currently manager for the coordinating activities of slum clearance projects with Skidmore, Owings & Merrill in New York City, on May 15 received the Gold Medal of the Society of American Military Engineers for his distinguished service as SAME's director on the Engineers Joint Council Board and Executive Committee. Presentation of the George W. Goethals Medal was made to **Samuel D. Sturgis, Jr.,** Lieutenant General, U.S. Army (retired), for his "eminent and notable achievement as chairman of the United States Section, International Passamaquoddy Engineering Board" in his capacity as chief of engineers. For outstanding contribution to military engineering by a member of the U.S. Navy Civil Engineer Corps, **W. Orme Hiltabidle,** Vice Admiral (retired), received the Moreell Medal, while the Army counterpart, the Wheeler Medal, went to **Carlin H. Whitesell,** Colonel in the Corps of Engineers, for his work as engineer on the construction program in Greenland, Iceland, Azores, New Foundland, and Canada, and as weapons systems director of Titan I construction for the Corps' Ballistic Missile Construction Office of Los Angeles. Lastly, the Bliss Medal for achievement in engineering education was received by **Lewis B. Combs,** Rear Admiral (retired), U.S. Navy Civil Engineer Corps, for "outstanding contributions to military engineering during his 14 years as head of the civil engineering department at Rensselaer Polytechnic Institute."

A. W. Compton recently resigned from Clyde E. Williams & Associates, of Indianapolis, Ind., where for the past several years he was chief engineer, to join the San Francisco firm of Leigh Fisher Associates, Inc., as president and general manager.

Robert S. Calkins, with over 21 years of experience as an engineer with the Soil Conservation Service of the U.S. Department of Agriculture at local, state, regional and national levels, including assistant head of the Soil Mechanics Laboratory, has established a consulting engineering service in Lincoln, Nebr. Mr. Calkins, who retired from the SCS two years ago, more recently was public health engineer for the Nebraska State Department of Health.

(Continued on page 25)

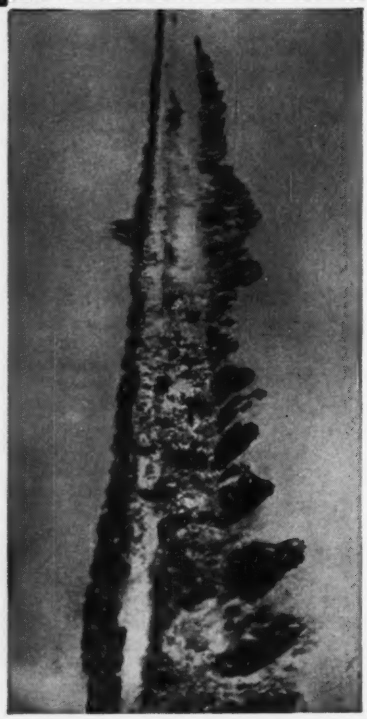
Seven years of field experience prove it! YOU CAN MAKE

FILLING RUTS AND DIPS. Adhesive and aggregate mixed in ratio of 1 to 5 is spread and troweled right over depressed area. No digging down to roadbed or exposing steel reinforcements.

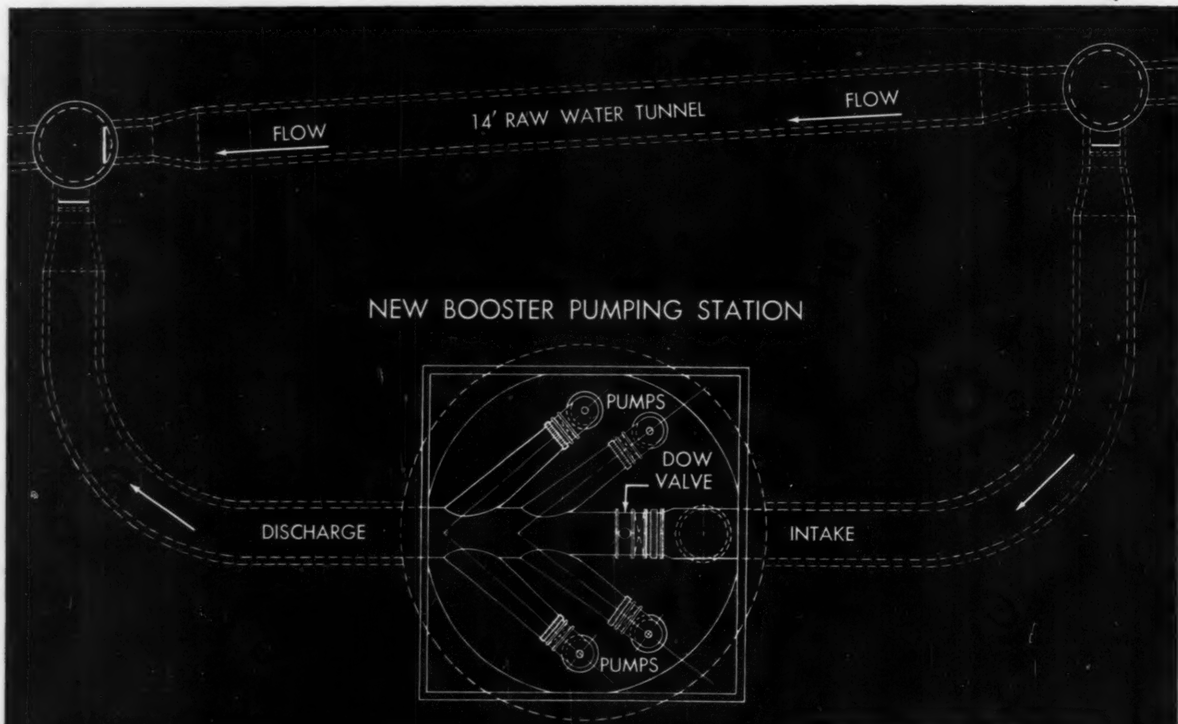
SPALLED JOINTS: Repaired in two hours by using polysulfide-epoxy mixed with aggregate as trowelable compound. Reduces tie-up time as much as 48 hours.

BROKEN ABUTMENTS: Restored stronger than new by brushing on polysulfide-epoxy adhesive to rejoin old concrete, or to bond fresh concrete to old.

FASTENING TRAFFIC MARKERS. Fixed to road surface with polysulfide epoxy adhesive alone, lane strips have stayed rigidly in place for long periods of time.



ALLIS-CHALMERS



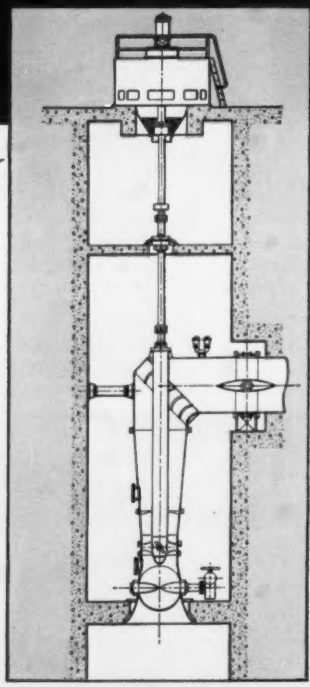
Each Adjustable-Blade Pump is rated to deliver 250 mgd under a 52-foot total dynamic head at 400 rpm. The pumps will be required to operate normally over a range of 22 to 40 feet tdh. A-C rubber-seated butterfly valves provide dependable pump check and suction chamber shut-off on each pump, and an A-C babbitt-seated Dow valve is mounted in pump manifold.

A-C Adjustable-Blade Pumps help City of Detroit augment raw water supply!

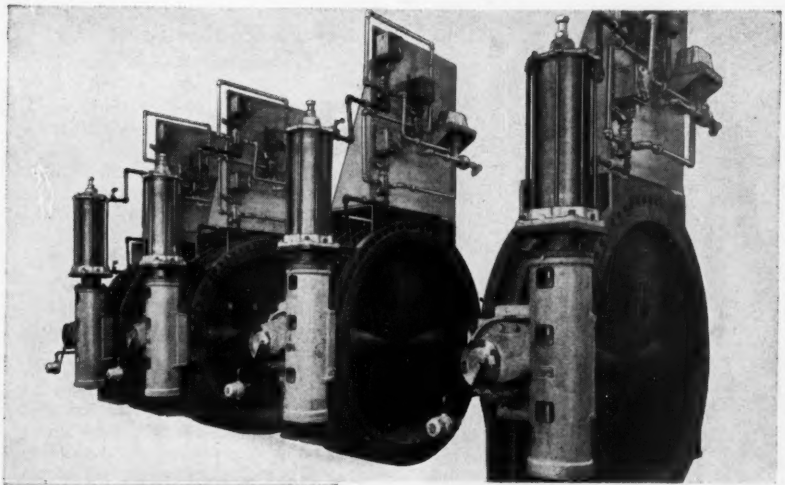
To augment the supply of raw water, Detroit, Michigan has installed four A-C Adjustable-Blade Pumps in a new booster pumping plant near the Detroit River. Pumps of this type were selected for their rapid, smooth response, under automatic control, to a wide range of flow demands.

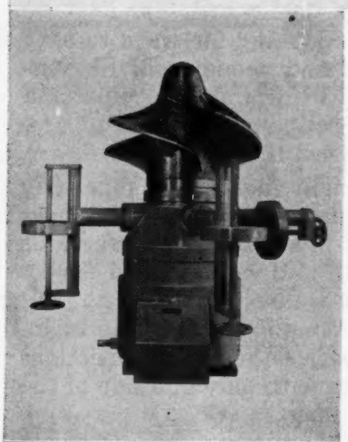
Adjustable-Blade Pumps will vary in output to meet the gradual changes in flow requirement as compared to stepped increments of flow and possible surges which would result if fixed-blade pumps had been installed.

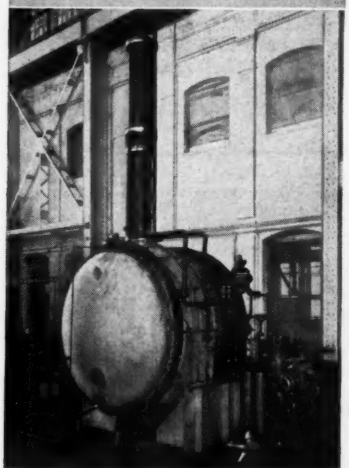
Two of these pumps will operate when required to raise the hydraulic grade line and supply adequate raw water to two remotely located treatment stations. As demand increases, a third pump will be used. A fourth pump is available for standby service. Pump blade angles are controlled automatically by a positioner responsive to downstream hydraulic grade line. A-1488



You may obtain full information on A-C Adjustable and Fixed-Blade High Capacity Axial Flow Pumps and Valves by writing to Allis-Chalmers, Hydraulic Division, York, Pennsylvania.







News of Members

(Continued from page 21)

R. A. Kampmeier, assistant manager of power of the Tennessee Valley Authority for nearly ten years, and prior to that chief of the power economics division from 1941 to 1947, and director of the division of power utilization from 1947 to 1951, was recently named Chattanooga's "Engineer of the Year." Currently, Mr. Kampmeier, who is also well known as an economist and administrator, is on leave with the Brookings Institution's Federal Executive Fellowship Program studying how best to apply to underdeveloped nations of the world the techniques of TVA and other Federal agencies.

Harold A. Vicker, vice president and chief engineer of the Pennsylvania Gas and Water Company since 1948, was recently elected a director of the utility.

James M. Rice, of the Natural Rubber Bureau, Washington, D.C., was elected president of the Association of Asphalt Paving Technologists at the organization's recent annual meeting. Mr. Rice, who is widely known for his technical papers and other activities on research and testing of paving materials, is consultant to the Natural Rubber Bureau on the use of rubber in roads.

Kenneth G. Wilkes, until recently supervising engineer in the Design and Construction Branch of the California State Department of Water Resources, is now chief in the Branch's Southern District Office with principal responsibilty for directing design and construction activities on the southern portion of the California Aqueduct Project. His predecessor, **Robert B. Jansen,** has been transferred to Fresno where he is district manager of the San Joaquin District.

P. Clifford Sharp announces that Haskins, Sharp & Ordelheide of Kansas City, Mo., the successor firm to Haskins, Riddle & Sharp, will continue to offer the same professional engineering services as has the latter firm in past years.

R. E. Van Liew, Captain in the U.S. Navy Civil Engineer Corps, is being transferred from his present duty as public works officer of the Naval Station at San Diego, Calif., where he has served for the past three years, to the Canal Zone.

C. G. Davis, construction manager at the Stone & Webster Engineering Corporation, of Boston and New York, where he has been employed for the past 24 years, has been elected a vice president by the firm's board of directors.

O. J. Miller has been named president of the Southeastern Electric Exchange. At the present time executive vice president of the Duke Power Company, of Charlotte, N.C., Mr. Miller prior to his promotion in 1956 was vice president and general manager of the firm.

(Continued on page 27)

News of Members

(Continued from page 25)

Harry E. Lloyd, formerly general manager and chief engineer of the Hetch Hetchy Water and Power Project and the Utilities Engineering Bureau of the City and County of San Francisco, Calif., has joined De Leuw, Cather & Company as an associate. Mr. Lloyd's offices are at 1256 Market Street, San Francisco.

Alan M. Voorhees, after nine years of service on the traffic engineering staff of the Automotive Safety Foundation, left the organization last month to establish his own consulting firm, Alan M. Voorhees and Associates, in Washington, D.C. In his work with the Foundation, he has developed several widely used techniques for projecting future traffic patterns on the basis of land use.

E. G. Prentzas has been appointed general manager of the structural concrete division of the Meriwether Supply Corporation in Shreveport, La. He was formerly chief engineer with Leap Structural Concrete in Atlanta, Ga.

Thomas M. Stetson, as president of Stetson, Strauss & Dresselhaus, Inc., civil and consulting engineering specialists in water supply engineering, announces the opening of a new office in Newport Beach, Calif. Other firm offices are located in Oceanside, Porterville, and Los Angeles, Calif.

Montague S. Hasie, III, has returned to Lubbock, Texas, to become associated with the firm of Hasie & Green and Associates, established by his late father, Coleman L. Hasie and George P. Green in 1946. He was formerly employed by the Corps of Engineers at Fort Worth, Texas.

Robert W. Van Houten, president of the Newark (N.J.) College of Engineering, has been elected president of the American Society for Engineering Education for a one-year term beginning July 1. Dr. Van Houten has served ASEE as a member of its General Council and as vice president for the eastern sections.

T. E. M. Wheat recently joined the Birmingham (Mich.) architectural firm of O'Dell, Hewlett and Luckenbach Associates as chief structural engineer. Mr. Wheat was previously head of the structural department at Eberle M. Smith Associates, of Detroit, and was in charge of the structural design of the Henry Ford Community College, a multi-building campus development currently under construction in Dearborn, Mich.

Reed A. Troxel has been admitted to partnership in the Syracuse engineering office of Stuart H. Snyder, under the new name of Snyder & Troxel. Mr. Troxel was project structural engineer with the architectural-engineering firm of Bellman, Gillett and Richards, in Toledo, Ohio, prior to moving to Syracuse.

(Continued on page 28)

News of Members

(Continued from page 27)

R. Dean Collins and **Marcus J. Rice** are partners in the new firm of Collins and Rice, with offices at 1622 S. 5th Street, Springfield, Ill. With more than three decades of engineering experience between them, the partners and their associates will specialize in civil engineering projects such as the design of bridges and buildings.

Charles S. LeCraw, Jr., as the new assistant to the director in the market development division of United States Steel Corporation, Pittsburgh, Pa., in addition to working closely with all commercial department and research units of U.S. Steel will work with outside design and consulting engineering firms. Mr. LeCraw held various jobs in the engineering and construction field prior to joining U.S. Steel in 1955.

Charles W. Jones, who began his career with the State of California in 1919 as a draftsman with the Division of Highways, retired recently as supervising bridge engineer for the Bridge Department in Los Angeles after more than 41 years of service.

Harland Bartholomew, partner in Harland Bartholomew and Associates, has opened a new office at 412 Transportation Building, Washington, D.C. There are other offices of the firm in St. Louis, Honolulu, Atlanta and Memphis.

Harold P. King, prominent California consulting engineer, was installed as president of the Consulting Engineers Council last May. A structural engineer and partner in the Sherman Oaks firm of King, Benioff & Associates, he was previously first vice president of the Consulting Engineers Council. New treasurer of the Council is **George W. Poulsen, Jr.,** who since 1948 has practiced civil and mechanical engineering as a consulting engineer at Salt Lake City, Utah. In the past he has served the Council as a director and vice president.

Richard E. Lander has been promoted from assistant plant manager at the Keasbey & Mattison Company's asbestos-cement pipe manufacturing facility at Ambler, Pa., to plant manager. Mr. Lander has been associated with K&M as a research engineer since 1959.

Herbert A. Howlett, a civil engineer with the California Department of Water Resources since 1937, has been named director of the new San Jose district office. At the present time Mr. Howlett is deputy division engineer in the Department's division of resources planning.

Harold K. Pratt recently became chief civil and hydraulic engineer of the Stanley Engineering Company, of Muscatine, Iowa, after earlier service as project engineer for the Bechtel Corporation. He also served with the Corps of Engineers for 20 years in various capacities.

. . . . . Am-Soc Briefs

▶ ▶ July 20 is the deadline — for balloting on the proposed amended Code of Ethics, which is now in members' hands for ratification. For the first time an interpretive "Guide" — prepared by ASCE professional committees — accompanies the Code. This should be useful in clarifying rules of conduct. Before returning their ballots — remember they are due at headquarters on or before July 20 — members may find it helpful to study the present code (page 42), on which proposed changes and omissions have been indicated in special type face.

▶ ▶ UEC Open House . . . . A once-in-a-lifetime feature of this year's Annual Convention — to be held in New York, October 16-20 — will be the "Open House" at the new United Engineering Center, set for October 19. Though the Society has long since reached its assigned quota for the new Center, informal campaigns still continue among interested Sections and groups.

▶ ▶ The Brazil Section, for instance, has asked the Society to contribute its allotment for two years to the Center fund. . . . Another case in point is Chi Epsilon, national civil engineering fraternity, which is campaigning actively to raise funds for furnishing a formal Conference Room on the ASCE executive floor of the Center. Gifts from friends of Chi Epsilon will be much appreciated. For a modest sum, you can memorialize a venerated engineer while making your gift. Data for contributors are supplied on page 77.

▶ ▶ Dividend in June. . . . The ASCE Group Life Insurance Plan is paying its first dividend, to take the form of credit on the June 1st quarterly billing. This most recent Life Insurance Plan, which has enrolled some 1,700 members in its first year of operation, is part of the Society's insurance program for the membership, in existence since 1949.

▶ ▶ Appeal for back issues. . . . Back issues of the Division Journals are in such demand that staff headquarters finds itself unable to assemble a complete set for the ASCE Publications Room at the UEC. Members who can help complete the file will be doing the Society a good turn. Needed issues are listed on page 80.

▶ ▶ Changes in Transactions. . . . By now members will have received a descriptive brochure outlining changes that have been made in the Society's Transactions. Is your order for the improved Transactions among the thousands that have already been received at Society headquarters?

do you know that

The business picture is better but spotty? As straws in the wind at the end of April, the Bureau of National Affairs cited: A rise in steel output for the sixth consecutive week; plans for boosting second-quarter output of automobiles, though rate of output is still 17 percent lower than in 1960; and a 50 percent increase in March orders for machine tools. On the other side of the picture there is an 8 percent vacancy rate in housing for the first quarter, up from 7.2 percent a year earlier. The consumer index was unchanged in March, at 127.5 percent of the 1947-1949 index.

▪ ▪ ▪

About 26 percent of the Interstate Highway System is now open to traffic? In actual mileage, this means 10,600 miles of the projected 41,000-mile national highway net. In the twelve-month period ending March 31, some 1,865 miles were completed to final standards. Figures are from Federal Highway Administrator Rex Whitton, F. ASCE.

▪ ▪ ▪

The Army is testing an amphibious crawler tractor? Called the UET (universal engineer tractor), the multipurpose unit can serve as a scraper, grader, cargo carrier, dump truck, and high-speed prime mover. It can keep afloat and propel itself in water. Finally, to meet the demands of modern warfare, it has been designed to travel by air and to be dropped (by six 100-ft parachutes) wherever it is needed. The UET was designed by International Harvester's Construction Equipment Engineering Department, and is being tested at the Army Engineer Research and Development Laboratories at Fort Belvoir.

▪ ▪ ▪

Use of prestressed concrete for bridges jumped in 1960? Figures released by the Bureau of Public Roads show that prestressed concrete was used for 12.3 percent of the nation's bridges in 1960 as against an annual average of 9.7 percent in the three preceding years. For the Interstate System, 392 prestressed bridges were authorized last year, compared with a total of 648 prestressed bridges built during the entire preceding three-year period. Pennsylvania led the other states with 83 prestressed bridges built in 1960. Texas was next with 56, and California and Michigan tied for third place, with 50 each.

▪ ▪ ▪

Venice is sinking into the sea at a faster rate than ever before? At the present rate of sinking—five times as fast as in 1950—experts expect that, in a few decades, St. Mark's Square will be awash at high tide and that, in a few centuries, the ground floors of many famous structures will be flooded. Before the end of the century it may be necessary to close off the passages connecting the lagoon, on which Venice is built, with the Adriatic. One of the problems resulting from this "solution" would be getting rid of the sewage, which is now removed by the tide. As an immediate corrective measure, City Engineer Eugenio Miozzi is advocating the closing of all artesian wells.

▪ ▪ ▪

The Interstate Highway Program will cost more than many big U.S. projects? To give an idea of its enormity, *Highway Magazine* (monthly publication of Armco Drainage and Metal Products, Inc.) estimates that the total cost of $41 billion will be 35 times the bill for the Panama Canal, for Grand Coulee, or for the St. Lawrence Seaway.

▪ ▪ ▪

This April the World Health Organization celebrated its thirteenth anniversary? Its theme for 1961 is "Accidents Need Not Happen." This topic is of special significance in the U.S. where accidents are the fourth leading cause of death—and the first among persons under 35. The annual death toll for all age groups is 90,000, while some 47,000,000 other Americans are injured in accidents.

▪ ▪ ▪

Air pollution in the Los Angeles area is not new? In 1542 Spanish Explorer Cabrillo, after observing the smoke made by Indians burning brush, called San Pedro Bay the "Bay of Smokes." Then, as now, atmospheric conditions and topography combined to prevent the dispersal of air pollutants In making its final report the Air Pollution Foundation—created eight years ago to speed the elimination of smog in the area—claims that "the only remaining cause of Los Angeles smog is motor vehicle exhaust."

▪ ▪ ▪

The U.S. produces more than half the world output of plastics? It is followed by West Germany, Great Britain, Japan, Italy, France and Canada, in that order. Our thanks for this to a newsletter from Arthur D. Little, Inc., Industrial Research Consultants.

▪ ▪ ▪

Only 263 engineers received National Science Foundation fellowships this past year? The total number of awards in the sciences, mathematics, and engineering were 1,537. Cause for concern is the fact that only eight of the engineering awards were in the civil engineering field (including hydraulics and sanitary engineering). Prof. Ralph Fadum, F. ASCE, chairman of the ASCE Research Committee, suggests that civil engineers be more alert to their opportunities, so that civil engineering can attract its fair share of today's scholars. (To make it all easier, Chi Epsilon prepares an annual survey of graduate scholarships in civil engineering. The current listing is available from Michael A. Spronck, Chi Epsilon Fraternity, Martinsville, N. J.)

Practical action for the engineering profession

"Professional improvement requires sanctions as well as persuasion —sanctions exercised judiciously for clear purposes widely accepted by the profession."

G. BROOKS EARNEST, F. ASCE
President, Fenn College, Cleveland, Ohio
(Official nominee for President of ASCE)

Address given at General Membership Luncheon, Phoenix Convention of ASCE

"An engineer is a person with a degree from an accredited engineering school and licensed as an engineer under the law of one or more states." This is a new definition, to some a new concept and, to those who are not licensed, a definite challenge.

There are licensing procedures for engineers in all 50 states today. If the requirements in some states do not satisfy the standards of the profession, we should do what we can to raise them. Meanwhile, however, public licensing in all states and territories should be recognized simply as a matter of clarification of professional status. The scrap of paper duly authenticated by proper authority makes the whole difference. The difference is entirely arbitrary. We must know definitely who is and who is not an engineer at any given time, or we are not really a profession.

Perhaps, we talk too much about, and do too little for, our profession. I hasten to salute all we have done as necessary, proper, and admirable. The participation of the important engineering societies in the Engineers Joint Council for the pursuit of joint technical and professional interests has established our technical and professional community. The Engineers Council for Professional Development has brought about, through accrediting procedures, vast improvements in the standards of our engineering schools. The National Society of Professional Engineers has assembled much data and made useful recommendations on the advancement of professional status. How then can I stand here and seriously assert that these accomplishments, though necessary, proper and admirable, are not enough?

Not enough practical action

My general answer is that we have properly relied upon persuasion but not sufficiently upon practical action.

Let me immediately note an excep-

tion, a distinguished example we can profit by in all phases of professional development. I have already mentioned the Engineers Council for Professional Development, which has effectively raised the standards of engineering education. Did the ECPD use persuasion? Yes, of course. Does the ECPD rely exclusively on persuasion? Not at all; it also relies on accreditation. Has persuasion plus the sanction of accrediting or refusal to accredit been successful in raising the standards of engineering education? Yes, extraordinarily successful.

Who gave the ECPD the authority to accredit? This is unimportant. ECPD asserted its authority as a professional body. Nobody of any standing denied it had such authority. Its purposes were clear and widely accepted in the profession. ECPD exercises its accrediting authority judiciously and temperately.

What does the ECPD experience teach us as to other phases of professional improvement? I suggest the general lesson is this: professional improvement requires sanctions as well as persuasion—sanctions exercised judiciously for clear purposes widely accepted by the profession.

Let us see how this kind of practical action, combined with persuasion, might work out in practice. A salient fact about our profession is that the great majority of all engineers are employees, and employees are not usually accorded a full measure of professional status. Engineers are, in the main, employees of engineering firms and of corporate industry. The engineering firms understand and promote our professional aims. The corporations are unquestionably open to persuasion that the treatment of employed engineers as professionals is to their own interest.

The literature of our profession has many persuasive statements such as this one: "Industry and individual engineers should work toward a clear-cut distinction between professional engineers and subprofessional or preprofessional personnel." Such exhortations always receive a respectful hearing both by industry and by individual engineers. Too frequently, however, no practical action follows. Yet suppose the profession should adopt the definition of an engineer I have proposed, that is, an engineer is a person with a degree from an accredited engineering school and licensed as an engineer by a duly constituted authority?

Getting a license is a chore, of course, but the licensee acquires a new kind of respect for the engineering profession. This is precisely the kind of respect any profession demands from its members and especially from those who wish to become members. The morale of the licensed engineers rises at least one notch. This is a classification and entitlement policy as to engineers which is perfectly clear and easy to administer, which makes every engineer happy and every neophyte engineer ambitious.

What is the justice of requiring that all engineers be licensed? Of course the justice of the matter is that an engineer of potential talent, licensed or not, should have the title. This, however, is irrelevant. The engineering profession is not charged with the administration of justice. It is charged with the clarification of professional status. This can be done only by formal requirements defining that status exactly.

Aside from proper classification and entitlement, there are other standard complaints from engineers about professional status. Some of these have led me to wonder whether we are not asking help from company management where the essential requirement may be self-help.

Engineers and management

Management, I think you'll agree, listens to engineers, or almost anybody else, having sensible ideas about increasing profits or improving the company's competitive position. Many engineers, indeed, occupy managerial positions today because of helpful suggestions that they have made in the past. If closer relationships between engineers and management are desired only for the discussion of pay and conditions of work, can we blame management for a certain resistance? Management has to listen to union grievances. Similar grievances from engineers have the same ring in management ears. The recourse for the professional man with a deeply felt grievance is to resign for reasons given.

Let me now turn to more legitimate calls for help where we still, in my opinion, have not helped ourselves in a manner either sufficient or professional. We have pleaded for better professional employment conditions for engineers—for freedom from regulation by time-clock; for adequate working space and equipment; for assignments requiring professional talent; for clerical and technical assistance on non-professional tasks; for the time to write for professional publications; for on-the-job training and refresher programs; for the time, and expense money, to attend professional meetings; and for job-rotation of younger engineers. I am in accord with these pleas and note that some companies have, in fact, responded fully. I am sure that they did so because of a realization that professionally contented engineers serve better than those who, on good grounds, are discontented. Our persuasion has, as usual, been good. But where is the practical action? Where are the sanctions?

Establish and publish standards

I have no program, only a line of suggestions. I suggest that this Society and others in the Engineers Joint Council study and determine what is the actual practice of employers of engineers in their respective fields. When they know what is the practice, they can set standards to improve the practice where it needs improving.

When these standards are established, they should be published, together with a list of companies and firms whose practices meet the standards. We do exactly this in engineering education every year through the ECPD. This publication of standards and favorable listing of employers, revised on an annual basis, should be available to all engineers, young and old, who are seeking employment. Reaching the young will not be difficult. Placing the publication in the hands of the accredited engineering schools will accomplish that purpose.

If the favorable listing is conscientious, fair and accurate, unlisted employers of engineers may begin to have recruitment difficulties, particularly when looking for graduate engineers with good student records. These difficulties may lead such employers—ultimately most employers—to seek the favorable listing in all fields where a short supply and high demand for engineers prevail.

I do not make these suggestions lightly. I cannot overstate the care, the fairness, the accuracy called for by such a project. Yet engineers, above all other professionals, are used to doing what they do well, and doing it right the first time. When a lawyer loses a case, there is no necessary reflection on his competence. When a surgeon loses a patient to eternity, blame does not necessarily attach to the doctor. Yet when something made or built by an engineer fails, the engineer expects to lose, not just his client or his job, but his reputation. We engineers are not allowed material errors. If we think it feasible to set standards for conditions of employment, I expect the profession will approach the problems, no matter where they lead, in a manner befitting engineers. The problems may lead to unpleasant tasks in support of our professional obligations.

Let me give an example. Suppose an engineer has had a hand in the development of a new product. A competitor employs him solely to acquire his technical knowledge to produce a competing product based on that knowledge. This is a clear violation of the Canons of Ethics developed by the Engineers Council for Professional Development and accepted by many engineering societies. I quote the specific canon:

"The engineer will act in professional matters for each client or employer as a faithful agent or trustee."

The Code of Ethics of our own Society says the same thing.

As lawyers have been disbarred and doctors deprived of licenses to practice for comparable behavior, so should engineers. If the profession wishes to sanction better professional conditions of employment, it must also punish unprofessional conduct. Any due process resulting in a fair trial and judgment by his peers, can clear, or punish, any engineer so charged. If the finding is guilty, the punishment can reach only so far as the powers of the profession reach. Expulsion from membership and deprivation of license represent the limits. Our profession should go the limits. As to licenses granted by states, the appropriate engineering society, as complainant, should take the necessary steps under state laws to have the public licenses of persons guilty of unprofessional conduct revoked. If the duty of the engineering profession to the public means anything, it surely means this.

I have cited an example, the most unpleasant I can think of, to suggest the completeness and gravity which must characterize our practical actions to improve the conditions of professional employment. Should the profession undertake such grave action? I have heard it said that, until we do, we are not really members of a profession.

I have, of course, taken the easy case of the rare engineer who violates clear duties of trust. The hard, close cases involve the economics of engineering and the dignity of the profession. Engineers, though members of a profession, must eat. They must find clients. Clients must be charged fees. Nobody doubts that the prior work, qualifications, and fees of the engineer are discussable items with prospective clients.

We rightly ban self-lauditory advertising. What we really fear is the abuse. We fear false statements about prior work and qualifications. The truth or falsity of such statements is ascertainable by experienced professionals in the specific fields of engineering in any particular case. I believe that in a tentative, cautious, conservative way we can develop workable interpretations of the principles of ethics that could make engineering practice profitable and make enforcement of the ethics possible.

What about income?

Closely related to the establishment of professional conditions of employment are the problems of professional standards of pay. I confess I am in a quandary on this question. I do not know which we should do—little or nothing.

The results of a recent survey conducted by the Engineering Manpower Commission of Engineers Joint Council are reported in the February 16, 1961, issue of the *Engineering News-Record*. The report states that "engineers' salary levels rose approximately 5 percent per year between 1958 and 1960. . . .", and that the median salary of all engineers in 1960 was $9,600 compared with $6,500 in 1953. This is a 49-percent increase in seven years, which "is well ahead of the rest of the economy. In the same period production workers in manufacturing increased their wages by 26.8 percent and the consumer price index rose 10.5 percent."

This report confirmed my former viewpoint that engineering income is good and getting better. The situation, I think, is professionally sufficient. My viewpoint may be partially biased through long association with impoverished academic circles.

Engineering salaries must be defended on professional grounds. Can the employers of engineers afford to pay more? Of course they can. Are engineers worth more? Of course they are. Yet I do not consider these tests professional in character. Our professional interest is the maintenance and growth of the profession of engineering. The proper test is whether engineering income and the prospects thereof are sufficient to continue to recruit good young people to the profession. A topnotch engineering graduate can expect to start at $6,000. In ten years, according to the most recent NSPE salary study, he can hope to earn $15,000. After 20 years, he can hope to earn $24,000, and eventually, $35,000. If he is only average, he can expect to earn from $10,000 to $12,000 most of the years of his life. During the 1960's, the supply of engineers, confidently predicted by all students of the subject, will grow shorter in relation to demand. We can, with some confidence, expect that the profession's income will keep pace, perhaps keep ahead, of the rest of the economy. For all these reasons, I wonder which we should do about engineering income—little or nothing?

It seems fair to conclude that supply and demand in a free market is regulating the income of engineers. Civil engineers' salaries, according to the NSPE study, trail, but only slightly, the salaries of engineers in other fields. Certainly the supply is diminishing as reported in civil engineering enrollment trends in engineering colleges across the country. So the little I have to recommend suggests itself.

Increasing the demand for civil engineers

I would direct this Society's professional attention to increasing the demand for civil engineers. Federal, state and local road-building and slum-clearance programs should be encouraged. The water, sanitation and drainage systems of many of our greatest cities need fundamental repair and new construction. The American neglect of water conservation, judging by the situations in Ohio recently documented by the *Cleveland Plain Dealer*, has the makings of a national scandal. We have whole industries, too, whose plants are outdated and outclassed by new construction and less expensive operations in Germany, Italy and the Soviet Union—to name only the leaders. I believe the Society can, with dignity, advocate the necessary action in high quarters on grounds that are purely professional and in the public interest. Any positive results whatever would tend to enhance the demand for civil engineers.

I have asked some questions about how to improve the status of our profession. I have answered these questions in a manner calculated to arouse in you some independent thinking, possibly to the joy of a skirmish on the issues. I have a duty to raise a final question. It is this: if the necessity of practical action as well as persuasion is granted, to whom shall engineers look for impetus toward action in improving professional status?

We must look to the civil engineers, I believe, and specifically to the American Society of Civil Engineers. We have been historically the central figures in the engineering profession we founded. We still are.

Accordingly, I believe the chief impetus toward the improvement of the engineering profession must come from the vision, the courage, the practical understanding of the civil engineers. Others must help, but our continued leadership will be good for us, for the profession, and for the country.

SIGNING NEW JERSEY ROADS

WILFRED WATSON, Sign Engineer, New Jersey State Highway Department, Trenton, N.J.

A driver cannot be permitted to slow down to read signs on high-speed highways. The slightest interference with normal traffic flow can contribute to the "chain-reaction" type of accident to which traffic of this type is subject. Studies have indicated that the average person cannot assimilate over three lines of information on a highway sign while at the same time performing the tasks necessary to maintain his position in traffic.

Policy on place names

Signing must be clear, concise and easily read from a distance, with advance signing to give the driver plenty of time to consider his tactics and maneuver his vehicle out of the main flow of traffic with no friction to through movements. The structural design of a sign and the selection of the material for it is an important but simple engineering problem compared to that of selecting two names only to be placed on it at a given location.

There is a great amount of rivalry among communities which consider directional signs as an advertisement. A strict policy must be maintained to keep to designations that are of value to the stranger not familiar with the area. The policy of the New Jersey Highway Department is to show two, or not more than three, designations at intersections. The most important communities are considered to be those reached by turning off the main route, using a straight through designation only where doubt may exist between the main roadway and the turnoff, such as at a Y-intersection as shown in an accompanying photo.

The basic policy is to show the next important road junction, communities at the end of a route, and prominent areas or facilities that are significant to the traveling public. The size of the community has no bearing on this decision. Confirming signs for motorists staying on the main road are located well beyond the intersection. They may have three designations, with mileages for through traffic.

The more general use of route numbers would solve this problem but some drivers follow place names exclusively and become confused when they reach an intersection and find only route marker shields. This forces us to use both route numbers and place names.

Studies in California resulting from actual on-the-spot interviews with motorists indicate that most drivers traveling in strange territory make use of the many excellent road maps available. However, some people who undertake long trips depend on directional signing only and have no idea of the necessary turns and movements until a point of decision is actually reached. This lack of orientation may easily cause conflict if a driver is forced to make a hurried decision under pressure.

The best procedure to cover most conditions is the establishment of a standard continuity. First, where the distance between interchanges permits, a two-mile advance sign is placed, bearing the route number of the next intersecting road with two place names on this route. This allows a warning time of approximately 3 min, giving time to discuss this movement, and if traffic permits, a chance to pull off to the shoulder to consult a map. Following the two-mile sign comes a duplicate one-mile sign.

The next sign in the series is located at the beginning of the deceleration lane of the turnoff, bearing the same route marker and destinations of the advance signs with the addition of a vertical sloping arrow under the message. It is very important that no new information be introduced at this point to cause confusion and possibly destroy the carefully built-up continuity in the driver's mind.

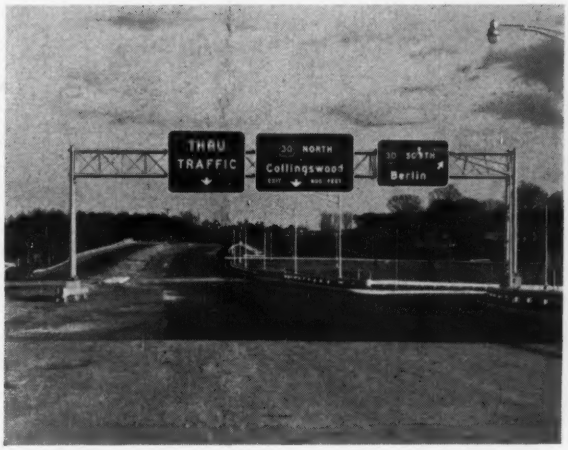
At the actual gore of the intersection is a sign bearing the message "Exit" with no other designation. It is believed that if the motorist is still in the traveling roadway at this point, there should be no information causing him to suddenly veer to the right, causing interference to both through traffic and the exiting movement on the deceleration ramp.

Most of the directional signs have capitals 16 in. high and lower-case letters 12 in. high. Since the length of the message dictates the width of the sign, sign widths vary from 12 ft for names such as Dover or Newark, to as much as 35 ft for the George Washington Bridge, Delaware Water Gap or Delaware Memorial Bridge. The height will vary from 6 to 9 ft, depending on the number of lines of copy and the letter size.

These large signs, with areas of from 100 to 300 sq ft, require mounting structures designed for a wind loading of 85 mph (about 37 psf) in New Jersey, with the necessary massive concrete footings. Overhead signs generally are mounted on special bridges, designed for the same wind loading, and with spans varying from 75 to 175 ft.

It is a common misconception that signs are a minor item and can be

Advance signing gives the driver time to consider his tactics and to maneuver his vehicle into the proper lane with the minimum amount of interference to through traffic. Previous signs for this turnoff were at the two-mile and one-mile points.



At a Y-intersection, signs indicate: (1) the community reached by turning off the main route, (2) the next important road junction, and (3) an indication of through traffic where doubt may exist between the main roadway and the turnoff.

treated as such. In the past, signs on the New Jersey highway system were constructed and erected by the Bureau of Maintenance. The obvious answer to the new problem of many more and larger signs, of unfamiliar materials, was to have the signs constructed and erected by contractors. To set up these signs in specifications and detailed plans requires considerable planning.

The first problem was the choice of materials—plywood or aluminum for the sign face and tubular steel or aluminum for the structure. The first impulse is to think only of permanence but other factors must be considered. The two standard types of aluminum signs are extruded sections—1 ft wide and practically any length—which are nested or bolted horizontally or vertically to make up the desired size of sign; or increment-sheet signs which, as the name indicates, are standard-size aluminum sheets fastened together with a system of locking devices on the rear of the sign. Both are excellent and proven methods.

The increment-sheet signs were available from only one source of supply at the time the original contracts were prepared. It would have been necessary to obtain a license from this concern to manufacture these signs, making it impractical to specify them.

The 1-ft-wide extruded sections were considered and put aside for more study. Objections were the cost, the banding effect on the face of the sign, and lack of knowledge and equipment on the part of New Jersey highway forces in maintaining these signs.

New Jersey has been using plastic-coated plywood for directional signs for five years with excellent results. Many are familiar with the material and shops are set up to handle plywood. It is expected that properly prepared material will last from 10 to 15 years. It is readily available from many sources, used by many other agencies, and is relatively less expensive than aluminum. For these reasons, the initial contracts were for plastic-coated plywood.

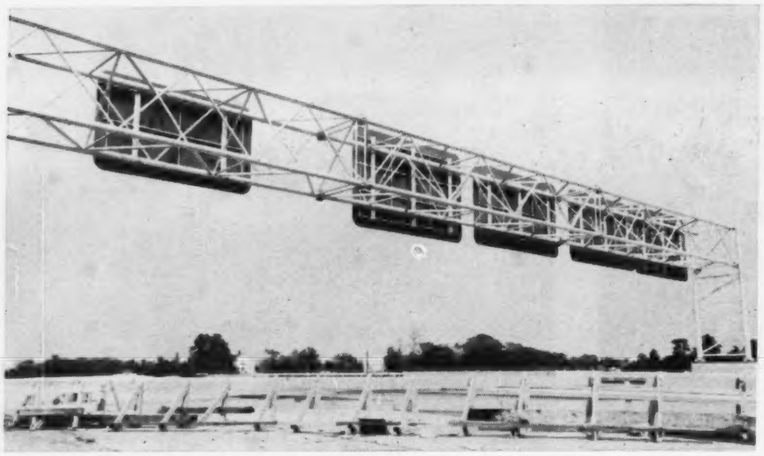
A new plywood sign was developed. Anchor nuts, or blind fasteners, are used in the back of the sign where through carriage bolts were formerly employed. This does away with the unsightly bolt heads in the face of the sign. The back stringers are aluminum Z-bars bolted into the anchor nuts; battens between adjacent sheets of plywood are ⅛-in. × 6-in. aluminium. The result is an attractive and structurally sound sign.

New Jersey does not use a reflectorized background on its directional signs. This policy is also followed in Federal Aid Interstate signing, except for non-illuminated overhead signs, for which a reflectorized background is specified.

Tubular aluminum will be used for ground-mounted sign supports. Originally tapered poles were specified, but as their availability in some sizes is limited, straight tubular poles are allowed as an alternate.

Both steel and aluminum have been specified for overhead structures. Contract prices indicate that steel structures in place cost from one-half to two-thirds that of a similar aluminum structure. A careful analysis of the cost differential between the two types is being made to determine whether the extra cost for aluminum will outweigh

The use of both route numbers and place names results in a minimum amount of confusion for most drivers.



Overhead signs are generally mounted on bridges designed for wind loads of 85 mph. Spans vary from 75 to 175 ft. Both steel and aluminum have been specified by the New Jersey State Highway Department, which is currently conducting a cost analysis of the two types of structures.

the eventual maintenance costs on steel units. There is no doubt that steel, properly maintained, should last for many years. To date our experience has not been sufficient to make a final judgment.

George Washington Bridge approaches

On the New Jersey approaches to the George Washington Bridge (F.A.I. Route 95, U.S. 46, 9 W and N.J. 4), most of the directional signs will be over the roadways. As all these ramps carry high-volume, high-speed traffic it will be impractical—if not impossible—to stop traffic long enough for any extensive maintenance operations.

One of the newer developments in sign materials is a permanent porcelain enamel baked on aluminum. By using this material, from 15 to 20 years of service is assured, with no maintenance except periodic cleaning. Porcelain enamel signs on aluminum extrusions, with aluminum supports and with exterior illumination, are expected to keep maintenance to a minimum. New materials are evaluated as they become available and are used if feasible and desirable.

After the major materials were decided on, the consulting engineers were directed to prepare details and specifications for the signs. As most of the contracts then under preparation involved major intersections, but no great length of roadway, it was practical to include the signing in the general contract rather than to prepare separate contracts. Where greater lengths of roadway are involved, consideration is being given to some separate sign contracts.

There has been much discussion on the advantages and disadvantages of separate contracts for signing. The first reaction is that they would allow direct competition between the actual fabricators giving lower bid prices and more flexibility in controls over materials and erection. However, unless projects are large enough to warrant the cost of preparing separate plans, advertising for bids and other incidentals, along with the necessary coordination with contractors working on other sections of the construction, the plan is to continue to include the signs in the general contract.

A complex bridge intersection

The George Washington Bridge approaches, with the new lower level, require a very complex intersection. It will be built in stages, involving changes in the traffic flow between stages. To include signing in any part of the contract would be impractical.

Temporary signing will be used and a separate sign contract, coinciding with the final construction stage, will be prepared. It is estimated that this contract, including electrification, will amount to a half million dollars. Several other complex sections in metropolitan areas are being considered for separate sign contracts.

In the general contracts, the signs seem to be a "nuisance item" to the contractors, involving materials and processes unfamiliar to the average contractor. On the first few contracts, bidding varied widely on some items. One particular sign assembly was bid at \$56, \$76, and \$270 in different contracts. Other signs varied proportionately. However, the largest items, directional signs and sign bridges, did not vary so much, and now show close bidding among contractors. "Bugs" in the first contracts, fortunately minor, have been overcome with the cooperation of the contractors, suppliers and engineers, and each succeeding job progresses more smoothly than the last.

Only one contract for signing has been completed to date to AASHO Interstate standards on New Jersey highways. The accompanying illustrations are from this contract, in which all the signs are of aluminum increment sheet mounted on aluminum supports. They were designed by Sherman, Taylor and Sleeper, consulting engineers, as part of the general contract. All those illustrated are on Interstate Route 295, which runs from the Delaware Memorial Bridge to the vicinity of Trenton.

(This article is based on a paper presented by Mr. Watson before the American Road Builders Association Convention in Atlantic City, N.J., in March 1961.)

At actual intersection, sign bears only the word "Exit." A place name here might cause a motorist in the through lane suddenly to veer to the right.

CARL R. WILDER, F. ASCE
Regional Conservation Engineer,
Portland Cement Association,
Los Angeles, Calif.

PHOTO 1. Subgrade trimming, lining and finishing on Main Canal, Columbia Basin Project, Washington, in 1947, are seen in aerial view. Bureau of Reclamation Photo.

Lower-cost canal linings through mechanization

About 25 percent of the water entering an irrigation system of unlined canals never reaches the farm, according to records analyzed by the U. S. Bureau of Reclamation. Losses in some unlined canals are much greater, and many large supply canals approach or exceed the classical loss of "one percent per mile." Lining can conserve much of this water. Fortunately, through mechanization, the cost of canal lining has been held reasonably constant since 1945, despite doubling of construction costs in general. New machines and improved controls have contributed greatly to this result.

Importance of conserving water

In the arid West and Southwest there is more arable land than there is water available for irrigation. Nationwide, the demand for water for municipalities, industries, and agriculture is increasing at a rate unimagined a decade ago. While water use in 1900 was about 40 billion gal per day (bgd), and currently is 240 bgd, a consensus estimate for 1980—only 20 years from now—is up to 600 bgd. These facts emphasize the importance of conserving and using all economically available sources of water. To do this requires not only the capture and storage of water, but also its transportation without undue loss.

Increased efficiency in water conveyance can, in many instances, be obtained through improvements to the canal system, which usually means some type of impervious lining. An idealist might maintain that all canals which leak at all should be lined, but engineers generally recognize that lining a canal is economically justified only when the annual benefits, including prevention of seepage, exceed the annual cost of the lining. Since the annual cost depends largely on the first cost and useful life, it is evident that the first cost of a canal lining has a very important bearing on the ratio of benefits to costs, which determines whether or not the lining is justified.

The quest for lower-cost canal linings started many years ago, but this article is confined primarily to developments since 1945. About that time a number of agencies and individuals were working on the development of lining materials and construction methods that would have a lower first cost. In 1946, the Bureau of Reclamation, which is this country's principal canal designing and constructing agency, established its "Lower-Cost Canal Lining Committee" to coordinate these efforts. Much progress has been made. Many new ideas for canal lining have been tried, a few of them have been accepted as proven or showing some promise, and more have been rather definitely eliminated from further consideration.

Two important results of the work of the Bureau of Reclamation on this problem have been:

1. Elimination of reinforcing steel from substantially all concrete canal linings, thus lowering their first cost and simplifying their construction.
2. Relaxation, to the greatest extent permissible hydraulically, of tolerances as to alignment and grade of concrete-lined canals.

For many years canals have been lined with concrete by slipforms supported on rails. The largest known machine of this type, spanning 112 ft between rails, was used in lining the Delta-Mendota Canal in California. Similar equipment was used on the Columbia Basin Project, Washington. See Photo 1. By careful setting of the rails and continual adjustment of the machine to previously surveyed line and grade, very close adherence to specified tolerances was readily attainable. With subgrade trimming equipment operating on the same rails and similarly adjusted, the thickness of the lining likewise was controllable within narrow limits.

Very small canals also were lined by similar rail-supported equipment. For the smaller canals with thin, unreinforced linings, the cost of setting and removing the rails and constantly adjusting the slipform to previously established line and grade was recognized to be a disproportionately large share of the total lining cost.

Subgrade-supported slipforms

Since as early as 1911 engineers have considered the possibility of using the subgrade, rather than rails, to guide and support slipforms for lining canals with concrete. In 1915 a subgrade-supported slipform was used to place concrete lining in canals of the Umatilla, Oregon, Reclamation Project. However, there were very few practical applications of this method until 1947 when Bureau of Reclamation engineers in Yuma, Arizona, built a subgrade-supported slipform and supervised its use for lining many miles of canals in the irrigated area near Yuma.

Also in 1947 a contractor of Phoenix, Arizona, designed and built a smaller slipform, of a size suitable for lining farm irrigation ditches. (Photo 2). He also built a plow (Photo 3) for

PHOTO 2. Small concrete-lined canal is constructed using Fullerton subgrade-supported slipform.

PHOTO 3. Plow manufactured by Fullerton Mfg. Co. is used to excavate and trim subgrade for concrete canal lining.

PHOTOS 4 and 5. Crawler-supported Hanson excavating and trimming machine maintains grade by a system of mercury switches and hydraulic controls.

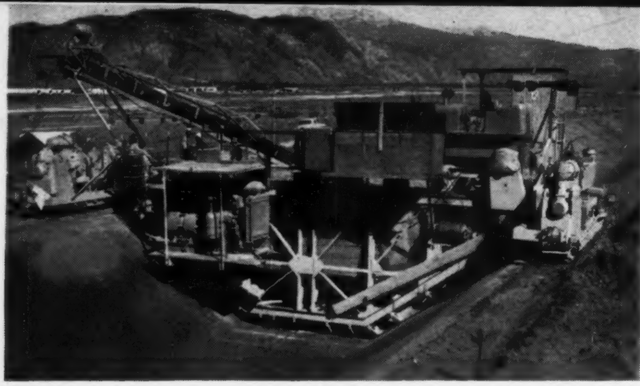


PHOTO 6. Crawler-supported trimming machine maintains alignment and grade on a canal near Hemet, Calif., by systems of mercury switches and hydraulic controls.

excavating and trimming the ditches preparatory to lining. Since 1947, this firm has built many plows and slipforms for sale and lease to contractors, irrigation districts and individual irrigators. Similar equipment of this type and size has been used to line thousands of miles of irrigation canals and ditches in most of the irrigation states, from Texas to Nebraska and Washington to California.

As the Bureau of Reclamation proceeded with the construction of irrigation distribution systems, additional contractors and equipment manufacturers became active in this field. In Washington, a contractor used mercury switches to maintain crawler-supported excavating and lining equipment level and to the specified profile grade. (See Photos 4, 5, 6 and 7.) With this equipment excellent control of grade was achieved. Many miles of canal in Washington, California, Arizona and Texas, from 2 to 8 ft in base width, have been built with this equipment since 1957.

Guide wire for grade control

In 1957, on a Corps of Engineers project in Los Angeles, a traveling form was used to place concrete lining in the bottom of the Los Angeles River. The equipment was similar to the slipform highway paving equipment previously used in Iowa, Colorado and other states, but with one important addition. This is a guide wire that steers the machine and keeps it on the specified grade by means of alignment and grade indicators mounted on the machine. These indicators, shaped much like tuning forks (see Photo 7), activate limit switches which bring hydraulic jacks into operation for grade control and regulate the speed of the crawler-tread motors for steering.

In 1959, the Metropolitan Water District of Southern California constructed 20 miles of concrete-lined water-supply canal near Hemet, Calif. The trimming and lining machines used on this work operated on the same principle of grade wire control used on the river channel work. (See Photos 6 and 8.)

During the 15 years from 1946 through 1960, slipform concrete lining, most of it unreinforced, was placed in over 18 million square yards of irrigation and water supply canals under Bureau of Reclamation contracts. These contracts included over 300 miles of small canals which were lined with subgrade- or crawler-supported equipment. Work currently is under way on projects to line several hundred miles of existing unlined irrigation canals in the Lower Rio Grande Valley of Texas. The writer knows of at least forty contractors, located in most of the 17 western irrigation states, who have, within the past five years, submitted bids on canal lining projects. Probably many more are in the business but confine their activities to the lining of farm ditches within a small area.

Evidently quite a few engineers, economists and irrigation district officials have concluded that lining at least some irrigation canals is economically justified. Careful consideration of the initial cost of concrete canal lining indicates that the lining of canals seems to be somewhat more justified now than formerly, and that this practice should continue to find favor in the future.

Construction cost trends

The trend of construction costs for concrete canal lining since 1946, and the *Engineering News-Record* construction cost index for the same period, are shown in Fig. 1. It will be noted that while the cost index was steadily rising, from about 320 at the start of 1946 to over 800 at the end of 1960, the unit cost of concrete canal lining was remaining reasonably steady, and actually falling in some areas. The lines in this figure, labeled from A to H, will be discussed individually.

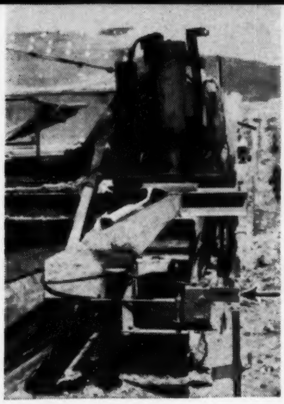


PHOTO 7. Wire, at arrow, guides grade and alignment on crawler-supported slipform.

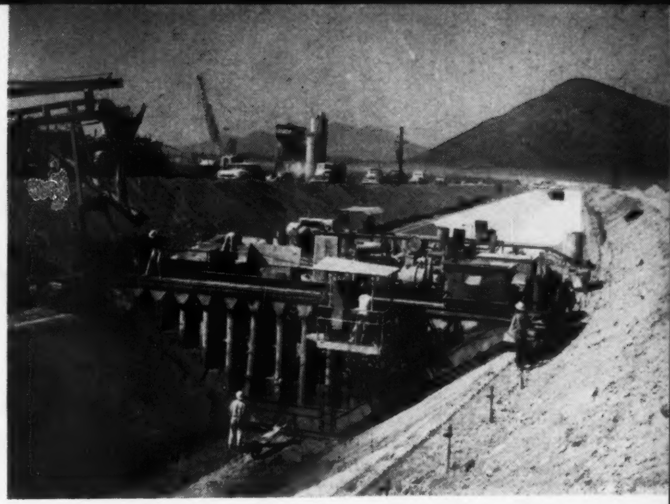


PHOTO 8. Crawler-supported Guntert & Zimmerman slipform paver places concrete in a canal near Hemet, Calif. Metropolitan Water District of Southern California photo.

Line A shows that during a five-year period, while the general cost index was increasing from 300 to 500, the unit cost of constructing 3½-in. concrete lining in the Friant-Kern Canal, in Central California, was decreasing from \$2.53 and \$2.54 per sq yd on the first two contracts, in 1946 and 1948, to \$1.71 and \$1.66 per sq yd on contracts in 1949 and 1950. The unit costs shown in Fig. 1, and discussed here, do not include excavation or incidental structures, but do include trimming the subgrade and furnishing, placing and finishing the lining. The five contracts representing the Friant-Kern Canal lining were reasonably comparable as to size of canal and total area. Similar rail-mounted trimming and lining equipment was used on all the contracts.

Line B represents the cost of 2-in. concrete lining in small canals and laterals of the Columbia Basin Project, Washington. The first point, in 1946, represents linings near Pasco, constructed by rail-mounted equipment at a unit cost of \$2.39 per sq yd. The next 2-in. linings in this project were constructed in 1955, and were built with subgrade-supported slipforms at a unit cost of \$2.81 per sq yd. It will be noted that while the cost index had doubled, from about 325 to 650, the concrete lining cost was increasing by only 17.5 percent. Unquestionably, elimination of the rails was largely responsible for holding the lining cost increase to this modest percentage. The first 1955 contract cost, incidentally, was the highest up to that time for 2-in. lining in the Columbia Basin Project, and five of the eight since then actually were lower than the 1946 unit cost.

Line C is of interest because it shows the cost trend for 4-in. concrete lining in California. The first seven contracts, from 1946 to 1949, were on the Delta-Mendota Canal, which was constructed with rail-mounted equipment. The last point on this line represents the lining of the Metropolitan Water District canal near Hemet, constructed in 1959 by equipment supported on crawlers. The weighted average cost for the seven Delta-Mendota contracts was \$1.87 per sq yd, while the unit cost for the Metropolitan Water District job was \$2.62, representing an increase of 40 percent. During the 9-year period between these two lining projects, the cost index increased by about two-thirds, from 450 to 750. The quantities involved in the three Delta-Mendota contracts showing the lowest unit costs were more than twice the quantity in the Metropolitan Water District contract.

Line D represents the cost of 4½-in. concrete lining in the Columbia Basin Project, Washington. The first six contracts, from 1946 to 1950, were for lining large irrigation canals such as that shown in Photo 1. The last contract, in 1957, was for lining a much smaller channel, the Esquatzel Floodway. The total quantity of lining involved on the latter job was less than in most of the earlier contracts.

Line E represents the cost of 2½-in. lining in small laterals of the same project. The eight contracts represented were reasonably comparable in size and local site conditions.

Lines F and G are for 2½-in. and 2-in. concrete lining, respectively, in small laterals of the Wellton-Mohawk Irrigation District near Yuma, Ariz.

Line H is for 2½-in. lining in existing unlined laterals of the Mercedes Irrigation District in the Lower Rio Grande Valley of Texas.

The form future developments and improvements in canal lining will take cannot be foreseen at this time. It is certain that the ingenuity of engineers and contractors, stimulated by the profit motive, will produce new, better, and still more efficient and economical ways of lining canals.

(This paper was originally presented by Mr. Wilder at the ASCE Phoenix Convention, before the session on "Conservation" of the Irrigation and Drainage Division.)

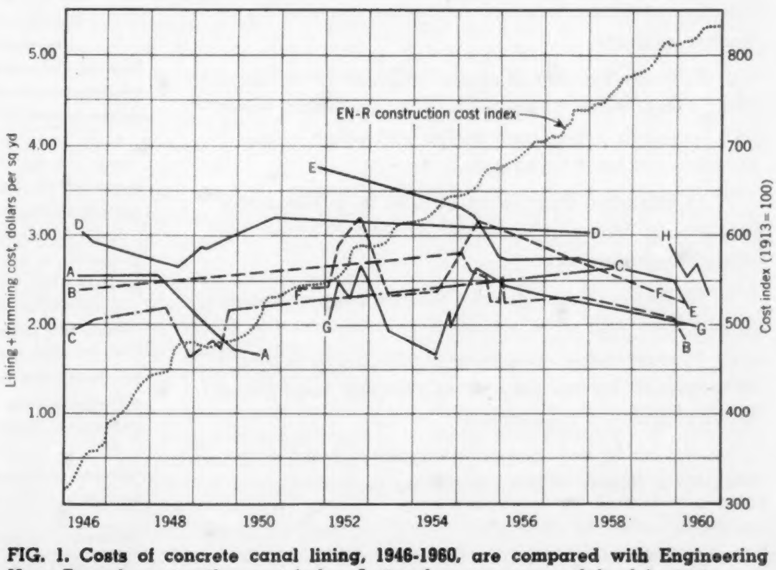


FIG. 1. Costs of concrete canal lining, 1946-1960, are compared with Engineering News-Record construction cost index. Lettered curves are explained in text.

CODE OF ETHICS as amended to be voted on by ASCE membership

An amended Code of Ethics, prepared by the Society's Committee on Professional Practice, was given the approval of the Board of Direction at its meeting in connection with the Phoenix Convention. At the Board's direction, the amended Code was sent to each member for ratification. Please return your ballot promptly.

For the first time the Code is accompanied by an explanatory statement designed to interpret the basic principles set forth and to show how they apply in practice. These interpretations, entitled "Guide to Professional Practice under the Code of Ethics," were formulated through committee work and discussion begun several years ago. For each of the ten articles of the Code there is an explanation, in one or more parts, giving rules of conduct for specific situations.

The principles stated in the present Code remain unchanged in the amended Code. The wording has however been clarified and made more concise. The arrangement also has been simplified. Following the two Codes, printed below, comes the "Guide to Professional Practice Under the Code of Ethics." The Board voted to adopt this Guide, subject to ratification of the proposed amended Code of Ethics by the membership. It directed that the Guide be transmitted to the membership with the amended Code but that the ratifying ballot be limited to the amended Code.

CODE OF ETHICS . . . (amended)

It shall be considered unprofessional and inconsistent with honorable and dignified conduct for any member of the American Society of Civil Engineers:

1. To act for his client or for his employer otherwise than as a faithful agent or trustee.

2. To accept remuneration for services rendered other than from his client or his employer.

3. To invite or submit priced proposals under conditions that constitute price competition for professional services.

4. To attempt to supplant another engineer in a particular engagement after definite steps have been taken toward his employment.

5. To attempt to injure, falsely or maliciously, the professional reputation, business, or employment position of another engineer.

6. To review the work of another engineer for the same client, except with the knowledge of such engineer, unless such engineer's engagement on the work which is subject to review has been terminated.

7. To advertise engineering services in self-laudatory language, or in any other manner derogatory to the dignity of the profession.

8. To use the advantages of a salaried position to compete unfairly with other engineers.

9. To exert undue influence or to offer, solicit or accept compensation for the purpose of affecting negotiations for an engineering engagement.

10. To act in any manner derogatory to the honor, integrity or dignity of the engineering profession.

CODE OF ETHICS (present, with amendments indicated)

It shall be considered unprofessional and inconsistent with honorable and dignified conduct for any member of the American Society of Civil Engineers:

1. (1) To act for his clients or for his employers ~~in professional matters~~ otherwise than as a faithful agent or trustee, (2) ~~or~~ to accept ~~any~~ remuneration ~~other than his stated charges~~ for services rendered **other than from** his client~~s~~ **or his employer.**

2. (5) To attempt to injure, falsely or maliciously, ~~directly or indirectly,~~ the professional reputation, ~~prospects, or~~ business**, or employment position** of another engineeer.

3. (4) To attempt to supplant another engineer **in a particular engagement** after definite steps have been taken toward his employment.

4. (3) To invite **or submit priced** proposals **under conditions that constitute price competition for professional services.** ~~for the performance of engineering services or to state a price for such services in response to any such invitation, when there are reasonable grounds for belief that price will be the prime consideration in the selection of the engineer.~~

5. ~~To compete with another engineer for employment on the basis of professional charges, by reducing his usual charges and in this manner attempting to under bid after being informed of the charges named by another.~~

6. (6) To review the work of another engineer for the same client, except with the knowledge ~~or consent~~ of such engineer, ~~or~~ unless ~~the connection of~~ such engineer**'s engagement on the work which is subject to review** ~~with the work~~ has been terminated.

7. (7) To advertise **engineering services** in self-laudatory language, or in any other manner derogatory to the dignity of the profession.

8. (8) To use the advantages of a salaried position to compete unfairly with **other** engineers. ~~in private practice.~~

9. (9) To **exert** ~~use~~ undue influence or **to offer, solicit or accept compensation for the purpose of affecting negotiations for an engineering engagement.** ~~commissions or otherwise to solicit professional work improperly, directly or indirectly.~~

10. (10) To act in any manner ~~or engage in any practice which will tend to bring discredit on~~ **derogatory to** the honor**, integrity** or dignity of the engineering profession.

Boldface = additions to present Code
Crossouts = deletions from present Code
Numbers in parentheses = Articles of amended Code
Other numbers = Articles of present Code

GUIDE *to Professional Practice Under the Code of Ethics*

Article 1. "It shall be considered unprofessional. . . . To act for his client or for his employer otherwise than as a faithful agent or trustee."

(1) He shall not undertake any assignment which would create a potential conflict of interest between the engineer and his client or his employer.

(2) He shall not disclose information concerning the business affairs or technical processes of his clients or employer without their consent.

(3) He shall not use information coming to him confidentially in the course of his assignment as a means of making personal profit if such action is adverse to the interests of his client, his employer, or the public.

(4) He shall not divulge any confidential findings of studies or actions of an engineering commission or board of which he is a member, without official consent.

(5) He shall not give professional advice which does not fully reflect his best professional judgment.

(6) He shall not misrepresent his qualifications to a client, to an employer, or to the profession.

(7) He shall not accept an assignment the results of which he will later act upon as a member of a public or quasi-public board.

(8) He shall act with fairness and justice to all parties when administering a construction or other contract.

(9) He shall engage, or advise engaging, experts and specialists, when in his judgment such services are to his client's or employer's best interests.

Article 2. "It shall be considered unprofessional. . . . To accept remuneration for services rendered other than from his client or his employer."

(1) He shall not accept compensation from more than one interested party for the same service, or for services pertaining to the same work under circumstances where there may be a conflict of interest without the consent of all interested parties.

(2) He shall not accept any royalty or commission on any article or process used on the work for which he is responsible, without the consent of his client or employer.

Article 3. "It shall be considered unprofessional. . . . To invite or submit priced proposals under conditions that constitute price competition for professional services."

(1) He may, where price competition is clearly not involved, discuss with the prospective client the scope and cost of engineering services.

(2) He may reply to a request for a proposal, wherein price competition may be involved, by advocating the procedure for selecting an engineer suggested in the current ASCE Manual on Private Practice of Civil Engineering.

(3) When requested, prior to negotiations for services and wherein price competition may or may not be involved, he may advise a prospective client in regard to:

(a) Qualifications and availability.

(b) Scope and probable cost of engineering work by reference to published schedules of fees such as shown in the current ASCE Manual on Private Practice of Civil Engineering, or by reference to comparable work of similar scope.

(4) He shall not submit a priced proposal, written or verbal, which includes a stated fee or estimated range of fees in any form in response to:

(a) A public advertisement for bids.

(b) Any invitation if there is reason to believe that multiple invitations have been issued and that price will be the primary consideration.

(5) He shall not be a party to requesting two or more priced proposals for comparative purposes where price is to be the primary consideration.

(6) He shall not solicit an engineering engagement by reducing charges after being informed of proposals of others.

(7) He shall not submit a proposal for an engineering engagement unless he is invited to do so.

Article 4. "It shall be considered unprofessional. . . . To attempt to supplant another engineer in a particular engagement after definite steps have been taken toward his employment."

(1) He shall not continue to seek employment on a specific engagement after being advised that another engineer has been selected subject to approval of detailed arrangements.

(2) He shall not solicit or accept employment from a client who already has an engineer under contract for the same work not yet completed or paid for.

(3) He shall not, in the event that another engineer has made a study and report on a specific project, approach the prospective client regarding subsequent phases of the project, unless such contract is initiated by the client.

Article 5. "It shall be considered unprofessional. . . . To attempt to injure, falsely or maliciously, the professional reputation, business, or employment position of another engineer."

This does not remove the moral obligation to expose unethical conduct before the proper authorities. Neither does it preclude a frank but private appraisal of employees or of engineers being considered for employment.

Article 6. "It shall be considered unprofessional. . . . To review the work of another engineer for the same client, except with the knowledge of such engineer, unless such engineer's engagement on the work which is subject to review has been terminated."

The article as stated is believed to be sufficiently explicit. However, even though the first engineer's services have been terminated, it is a matter of common courtesy to let him know that his work is being reviewed.

Article 7. "It shall be considered unprofessional. . . . To advertise engineering services in self-laudatory language, or in any other manner derogatory to the dignity of the profession."

(1) The following are considered to be permissible:

(a) Professional cards in recognized, dignified publications, and listings in rosters or directories published by responsible organizations, provided that the cards or listings are consistent in size and content, and are in a section of the publication regularly devoted to such professional cards. Information given must be factual, dignified, and free from ostentatious, complimentary, or laudatory implications.

(b) Brochures, provided that they are confined to factual statements of experience, facilities, personnel, and capacity to render service, and are not misleading with respect to

the engineer's direct participation in projects described.

(c) A statement of his name or the name of his firm and statement of his type of service posted on projects for which he renders services.

(d) Preparation or authorization of descriptive articles for the lay or technical press, which are factual, dignified and free from ostentatious or laudatory implications. Such articles shall not imply anything more than his direct participation in work described.

(e) Permission by an engineer for his name to be used in commercial advertisements, such as may be published by contractors, material suppliers, etc., only by means of a modest dignified notation acknowledging the engineer's participation in the project described.

(2) He shall not use any commercial advertising media in connection with his engineering practice. Undesirable forms of advertising include newspaper and magazine space advertisements, indiscriminate direct mailings, and radio and television time, as well as items bearing his name such as pencils, blotters, etc.

Article 8. "It shall be considered unprofessional. . . . To use the advantages of a salaried position to compete unfairly with other engineers."

(1) He shall not engage in outside engineering work to an extent prejudicial to his salaried position or detrimental to established engineering services, or which would result in a conflict of interest.

(2) He shall not compete unfairly by charging fees below those customary for engineers practicing in the same field and in the same area.

(3) If permitted by his employer, his outside activities should preferably be confined to consultation on phases of engineering for which he has special qualifications not inherently available in usual engineering practice. Also, he would not ordinarily establish an office for the purpose of conducting such outside activities.

(4) He shall not use the influence of a salaried position to direct clients to an engineering office in which he has financial interest.

Article 9. "It shall be considered unprofessional. . . . To exert undue influence or to offer, solicit or accept compensation for the purpose of affecting negotiations for an engineering engagement."

(1) He shall not make political contributions for the purpose of influencing the selection of engineers on future engagements.

(2) He shall not give or receive any payments for the purpose of influencing the selection of an engineer for an engineering engagement.

(3) He shall not create obligation on prospective clients or employers through extravagant entertainment, gifts, or similar expenditures.

(4) He shall not engage in "fee splitting" or other distribution of fees for other than services performed and in proportion to the value of such services.

(5) He shall not solicit or accept an engineering engagement, or submit a proposal or contract covering engineering services when payment for such services is contingent upon results supporting a predetermined conclusion or upon a favorable finding with respect to economic feasibility.

(6) He shall not request, propose or accept an engineering engagement on a contingent fee basis if the contingent basis or the contingent services performed influence the selection of the engineer.

Article 10. "It shall be considered unprofessional. . . . To act in any manner derogatory to the honor, integrity or dignity of the engineering profession."

(1) He shall not be associated in responsibility for work with engineers who do not conform to ethical practices.

(2) He shall express an opinion only when it is founded on adequate knowledge and honest conviction while he is serving as a witness before a court, commission, or other tribunal.

(3) He shall not issue statements, criticisms, or arguments on matters connected with public policy which are inspired or paid for by private interests, unless he indicates on whose behalf he is making the statement.

(4) He shall refrain from expressing publicly an opinion on an engineering subject unless he is informed as to the facts relating thereto.

(5) He shall exercise due restraint in criticizing another engineer's work.

(6) This article appropriately may be considered as a summation of the entire Code. It requires that a member of the Society shall act in accord with high standards of moral conduct under any and all circumstances.

Ethics for projects outside the U.S.

In a separate action the Board voted to adopt the following policy for the guidance of Society members engaged on projects in countries outside the United States of America:

"A member who is engaged in engineering work in a country abroad shall order his conduct according to the professional standards and customs of that country, adhering as closely as is practicable to the principles of the ASCE Code of Ethics."

Improved curricula for land surveyors endorsed by ASCE

For several years the subject of upgrading curricula for land surveyors has been under study by ASCE committees. At its Phoenix meeting the Board of Direction considered a recommendation of the ASCE Committee on Engineering Education with regard to instruction in surveying in the accreditation of civil engineering curricula. It was voted to adopt as Society policy the recommendations advanced and to implement them through the Engineers' Council for Professional Development.

The policies for accrediting curricula are as follows:

"1. Civil engineering faculties should be encouraged to provide appropriate instruction in surveying by qualified personnel.

"2. Some of the engineering schools throughout the country should provide an elective sequence of surveying and mapping subjects that would comprise, in effect, an undergraduate major in survey engineering (or geodetic engineering or geometronic engineering).

"3. That some engineering schools should offer graduate-degree programs in major specialties of the survey engineering field, such as: land surveying, geodetic, cartographic, and photogrammetric engineering.

"4. That all employers of professional-level surveying and mapping personnel be encouraged to assist those schools that are willing to establish the educational programs listed in (2) and (3) above, by recommending promising students for enrollment, by offering part-time employment to students, by providing funds for scholarships and assistantships, and by employing graduates of such programs."

Metropolis 1980—New York Convention Theme

New York's usual myriad attractions await ASCE members who attend the Annual Convention, to be held at the Statler-Hilton Hotel in New York City, October 16-20. This year's Convention, the first to be held in New York in three years, is the last of only two Society Conventions scheduled for 1961. Following the trend of recent national Conventions, the New York meeting will have the general theme of "Metropolis—1980." All the Society's fourteen Technical Divisions are expected to sponsor sessions related to this general theme.

Another strong drawing card will be an "Open House" at the new United Engineering Center. Present plans call for moving from the Engineering Societies Building, on West 39th Street, to the new Center, on United Nations Plaza at 47th Street, about the middle of August. The Open House is scheduled for Thursday, October 19, and by then the daily routine in the new center should be well established.

In addition to New York's thousands of long-standing attractions, there will be much that is new to startle and interest those who have not visited the city recently. For the past few years the city has been in the midst of an unprecedented building boom, with the result that many spectacular new buildings and improvement projects—completed and under construction—will greet Convention visitors. Among current construction projects engineers will want to see are the new Pan Am Building, which will be the largest office building in the world; pier building for the massive Narrows Bridge, which will have the longest suspension span in the world; and work on the second deck of the George Washington Bridge, with its allied network of approaches and its unique bus station, the first U.S. work of the distinguished Italian engineer, Pier Luigi Nervi.

The fourth annual Civil Engineering Show will form a backdrop for this year's Convention. More than twenty-five exhibitors have already been signed up for what promises to be a fascinating display of the equipment and products that help make modern construction possible.

In developing the Convention theme of "Metropolis—1980," the program committee is working, through the Technical Divisions, on the following general subjects as the basis for technical papers:

Air Transport Division—Airport planning for 1980, including discussion of New York's International, La Guardia and Newark airports, and new types of planes.

City Planning Division—Strip concept versus radial concept in city design.

Construction Division—New materials and techniques.

Engineering Mechanics Division—Space structures.

Highway Division—Traffic control automation; design to meet requirements of new vehicles.

Irrigation & Drainage Division—Irrigation and water conservation for increased food production.

Pipeline Division—New lining materials; transport by pipeline.

Power Division—New demands and sources.

Sanitary Division—Potable water supply; waste disposal.

Soil Mechanics & Foundations Division—Geophysics engineering application.

Structural Division—Plastics as a structural material.

Surveying & Mapping Division—Space mapping relative to earth point location.

Waterways & Harbors Division—High speed (hydrofoil) shipping problems.

Hydraulics Division sessions are also under study.

Gardner M. Reynolds is general chairman of the Convention committee. Other committee members are: Carl A. Arenander, Brother B. Austin Barry, Austin E. Brant, Jr., John F. Brennan, George A. Burpee, Robert H. Dodds, Arthur J. Fox, Jr., Thomas J. Fratar, Otis D. Gouty, Martin S. Kapp, Donald D. King, Robert K. Lockwood, Stephen M. Olko, Malcolm Pirnie, Jr., Robert W. Richards, John E. Robinson, Gordon Wallace, and Richard Walter.

One of this year's unique Convention features will be an "Open House" at the new United Engineering Center, which is nearing completion on United Nations Plaza. Present plans call for moving the staffs of the participating societies to the new Center the middle of August.

ASTM Affiliates with EJC

The American Society for Testing Materials has been elected an affiliate member of Engineers Joint Council. The action was taken by the EJC board of directors at the organization's annual meeting. EJC now has ten constituent, three associate, and nine affiliate societies representing over 300,000 engineers. It was organized in 1941 to advance public welfare through utilization of the resources of the profession.

ASTM is a national technical society devoted to the promotion of knowledge of materials of engineering and to standardization of specifications and methods of testing. It has 10,500 individual and company members, plus some 6,500 non-member technical personnel serving on its committees.

Engineering and Technology for the World of Tomorrow

In an important address delivered at a special convocation of Technion, Israel Institute of Technology, Philip Sporn, F. ASCE, president of the American Electric Power Company, discussed the subject, "Science, Technology, and the Training of Engineers for the World of Tomorrow." Dr. Sporn, who is internationally known in the electric power field, received the honorary degree of Doctor of Technical Sciences at the special convocation, which was held at the Carnegie Endowment International Center, New York, in March. Excerpts from his timely talk follow.

Deploring what he sees as the present over-emphasis on science at the expense of engineering and technology, Dr. Sporn remarked, "I do not know what foundation there can be for the notion that science is today more important than technology. The fact is that there has been no revolutionary change in the relationship between science and technology. It has been a fruitful relationship going back as much as 100 years. The development from Faraday's scientific experimentation to modern electric power technology is one of the earliest, and perhaps the best, exemplifications.

"Science and technology are both important, and each derives expanded scope, meaning, and significance from the other. Science may be said to represent an evolving body of systematic, experimentally verifiable knowledge regarding the relationships among the complex phenomena of the physical world. Scientists are concerned with improving man's understanding of his physical world and expanding the range of physical phenomena embraced by man's understanding. The engineer or technologist, utilizing the knowledge made available by the scientist, develops the means for controlling man's physical environment and transforming the conditions of life. . . .

"In their simplest concept, technology and engineering are applied science. But technology is, I believe, really a great deal more than this. It embraces all human experience with science, tools, methods, systems, and organization that add leverage to man's effort and make possible much greater abundance than his unaided physical strength and skill alone could deliver."

Dr. Sporn believes that the confusion over the distinction between science and engineering and technology and the prevailing tendency to glorify the scientist, "with the accompanying, if subtle, downgrading of the engineer, has resulted in a great deal of damage." The inevitable result of this "tendency of recent years to derogate engineering," Dr. Sporn sees as responsible in large part for the decline in enrollment in our engineering schools and colleges and the corresponding rise in science enrollments.

To bring home "the importance of recognizing the indispensable role of engineering in bringing into fruitful use" some of the important scientific discoveries of our time, Dr. Sporn cited several "currently exciting technological developments, erroneously thought to require additional efforts of science rather than of engineering . . . before they reach fruition."

His first case in point was atomic energy. Noting that it was the scientists' viewpoint that dominated the early postwar development of atomic power generation, he saw the result as "a misdirection of effort and an induction of false hopes because of the failure to appreciate the problems of technological, as distinguished from scientific, development. The scientific basis for the nuclear generation of electric energy was . . . adequately known, but the difficulties to be overcome in the engineering implementation of the known scientific principles were overlooked. In particular, the engineering economic factors were not properly evaluated, and it was not adequately understood that the conventional fuel technology, which it was hoped would be displaced with nuclear-fuel technology, was in a phase of dynamic change and progress that presented a moving target, so to speak. Even more, there was a failure to recognize that, in its essentials, progress in nuclear power technology could best be obtained by building upon the existing and highly advanced power technology.

"Some, but not all, of these errors have now been rectified," he said, "and the fact that we are today quite well advanced along the road of making atomic energy competitive in the high-cost energy areas of the United States is due in large measure to the fact that for the last decade at least we have been concentrating on the engineering aspects of atomic-energy-generating designs rather than on the scientific aspects. Costs, questions of arrangement, questions of size, the problems of heat transfer, the problems of pressure suppression in case of rupture of a vessel under pressure, the problems of metallurgy both within and without the reactor, the problems of thermodynamic heat balance—all are now being given the consideration they require.

"The early hope of the scientific community for some startling breakthroughs in the development of atomic energy has been abandoned. And to the extent that we have not yet reached the goal of competitive atomic energy, it is not because the underlying scientific principles are not understood, but because of the difficulties encountered in solving the many complex engineering and economic problems. Much time was lost, however, before it was recognized from which partner of the science-technology team the real contribution was needed."

Dr. Sporn's second case in point was sea-water conversion. Here, too, he said, the considerable progress that has been made in recent years, "is due to advances in technology and to engineering improvements." Dr. Sporn went on to say that, "The basic science of getting the salt out of sea water is as old as recorded history. Julius Caesar and the ancient Phoenicians had already found the secret—just distill it. But the economic application of the simple fundamental principle to replace or augment natural water resources is a totally different affair. To bring this about, quite a few engineering problems and difficulties have to be solved.

"Fortunately, we have already made great strides in resolving many of these problems: In applying lower-cost materials to improved designs; in advancing the terminal temperatures of operation; in reducing scale and corrosion; and in seeking lower-cost sources of energy either through independent approaches or through integration with other more advanced technologies, such as power generation. This progress has been achieved only during the past decade or so, when necessity once more became mother to invention—engineering invention."

Dr. Sporn remarked: "There are altogether too few places where engineering students are given an opportunity to acquire a firm background in the liberal arts—in history, the history of science and technology, in economics, and political economy, the dynamics of political and social-economic

history, and in philosophical and cultural values. Nor are there many places where the attempt is made even to stimulate at least an awareness among engineering students of the importance of integrating these materials into their career activities . . . .

"We simply do not get enough people out of our engineering schools who are able to visualize the larger systems within which the narrow solutions must fit, who can see things in scale and can completely visualize the significance of large industrial complexes at a single location. The conceptualization of a vast aggregation of highly complex machinery and how it relates to the social-economic and even historical scheme of things is almost utterly beyond them.

"The engineer ultimately is not going to be judged by whether the machinery he has had a hand in designing rotates at a constant speed or a variable speed, or whether the temperatures of his metals are at 1,100, 1,200, or 1,300 deg F, or whether his unit stresses are 20, 50, or 100,000 psi. The judgment of society will be based on how the complex he creates functions in society—what it does for society. And by these standards our current engineering education is, by and large, deficient. . . .

Dr. Sporn noted that there are a great many things that need to be done and that can be done to improve the quality of our engineering education.

"First, there is a great need, I think, for our colleges to comprehend the idea that the 1960-1965 student body will not make the world of 1965 but will have the responsibility for creating the world of 1985. It is for this that they must be trained. We need always to remember that. I know how difficult it is to do long-distance crystal gazing, but unless you do that you cannot do the job of planning education . . . properly. The colleges and universities not only must never surrender their responsibilities or their historic tradition of being leaders of thought, they also must ever remember that they are educating men who will be leaders in thought.

"There is something, too, we could do about the student body entering our engineering schools. I believe all our engineering schools are weak because of the inadequacy of the student body. We just do not get a large enough share of our talented youth. I believe we must find some way to attract more of our young people into engineering schools, and we need to do a great deal of what I can best describe as beneficiation before we bring this talent into our engineering schools. Essentially, I believe, this requires a re-orientation of both the character and the tempo of training in our high schools and preparatory schools. I think a great deal can be done in this regard, and we have to find ways to do this work. We need to do a better job of finding and selecting the material that results from that beneficiation.

"The curricula that we establish for the people we bring into our schools—I won't say this has to be universal, but it is certainly true for a significant percentage of the group—need to be deepened and broadened. Their training must include a great many subjects we now hardly touch upon in our technical and engineering schools . . . In short, since he is going to be called upon to reach decisions that may have far-reaching effects on society, not only must he be capable of crossing traditional dividing lines in engineering, but he must develop a deep understanding of the social-economic forces at work in our own country and in the world."

Dr. Sporn pointed to the need to give more attention to training in synthesis and the "need to do a great deal more work on synthesis and the development of skills in synthesis—that is, the development of diverse elements into complex systems."

In conclusion, Dr. Sporn emphasized the need for increasing the contacts between students and engineers and for the strengthening of faculties. ". . . the students in our engineering schools, if they are going to be engineers and not merely highly successful, even brilliant, technicians, need to have a great deal of contact with engineering. They need to have much greater contact with industry. I myself, in our own company and in other ways, have had a great deal of contact with a number of the cooperative programs operated by our engineering colleges, but I do not believe these programs are widespread enough. We need more of them. They bring students into contact with engineers at an early phase of their careers, and this is to the good. It gives them a much more solidly based appreciation of engineering and of a career in engineering.

"I think we need to do something about faculties. I believe students of engineering need to be inspired to climb the heights of engineering. If they are going to be great engineers they ought to be exposed to at least a few great engineers. Certainly many of our great surgeons are people who were inspired by studying under the guidance of great surgeons. We do not have that, at least we do not have enough of it, in our schools of engineering. I believe this can be rectified by bringing some practicing engineers into our engineering faculties. There is a good technique for this—the adjunct professorship—which should be developed.

"The other side to this is the benefit derived by the practicing engineers from that contact. Engineers who practice engineering, who visualize, project, develop, and eventually see great engineering concepts become work in progress, can benefit by communicating some of their ideas to engineers in the making . . .

"Through science and technology we have learned how to provide a new scale of well-being in the material things of life while continually lessening the component of human labor necessary to produce these material goods. Only by maintaining a proper balance between science and engineering can this progress be continued."

Death Takes Honorary Member Arthur Surveyer

Members of the Society will be grieved to hear of the death of Honorary Member Arthur Surveyer, a distinguished Canadian engineer and specialist in hydraulics, who died in Montreal on April 17. He was 82.

A graduate of Laval University and the Ecole Polytechnique in Montreal, he also held several honorary engineering degrees from U.S. and Canadian universities. He began his career with the Department of Public Works of Canada in 1904. From 1911 until his death he headed his own private practice in Montreal—for many years under the firm name of Arthur Surveyer and Company, Consulting Engineers and of recent years under the name of Surveyer, Nenninger & Chenevert.

As a member of the St. Lawrence River Commission, he engaged in early studies aimed at resolving differences between hydroelectric and shipping interests. He also prepared an early report on the effect of the Chicago Drainage Canal diversion on St. Lawrence River and Great Lakes harbors. Dr. Surveyer served as director of many organizations, including the Shawinigan Water and Power Company.

Dr. Surveyer became a Member of ASCE in 1924 and was made Honorary Member in 1944. Dr. Surveyer was also prominent in the Engineering Institute of Canada, which he served as president in 1924 and 1925, being one of only four men in the history of the Institute to hold the office for more than a year.

(More ASCE News on Page 76)

Aerial photography aids pipeline location

PHILIP GUSS, M. ASCE, Development Engineer, Lockwood, Kessler & Bartlett, Inc., Syosset, N. Y.

Aerial photography, especially useful in pipeline location, is simultaneously a source of information, a tool, and a permanent, reproducible record for the engineer.

As a source of information, aerial photographs are unique.

1. Each photograph is a detailed replica of the natural and cultural features of a part of the earth's surface, permitting analysis of related features not apparent to an observer on the ground.
2. Overlapping pairs of aerial photographs provide the means for viewing the terrain in three dimensions, permitting the development of such basic information as surface geology, drainage, soil types, vegetation types, land use, land evaluation, and construction problems.
3. The geometrical characteristics of aerial photography permit transformation of terrain features into planimetric and topographic maps by photogrammetric techniques.
4. Aerial photographs are discreet where secrecy of planning is required, as in pipeline location within metropolitan areas where land values are high.

As a tool, aerial photography helps the engineer to define his problem, familiarize himself with the area of study, and plan field operations.

As a record, aerial photography provides permanent and reproducible evidence, and permits the development of engineering data primarily as an office procedure, unimpeded by restrictions of climate and accessibility. Work can proceed concurrently on related phases of a project, which formerly had to be accomplished in successive stages by standard field survey methods. And the photographs serve as legal evidence of terrain and man-made features prior to construction, if litigation arises at some future date because of zoning changes or residential encroachment.

Aerial photographic techniques

Compilation of terrain and cultural information from aerial photography is effected by close integration of photogrammetric and photo-interpretative techniques.

Aerial photogrammetry is concerned with the quantitative characteristics of the earth's surface. True-scale planimetric and topographic maps are compiled by optical or mechanical rectification of aerial photographs through the use of complex stereo-plotting instruments, to key the photo features to a skeletal network of ground control.

Aerial photographic interpretation derives reliable qualitative information concerning the nature and characteristics of the land from the analysis and evaluation of terrain and man-made features appearing on the photographs. This is accomplished by systematic examination of all elements of the air-photo pattern—land form, drainage, erosion details, photographic gray tones, vegetation, and cultural details—and deduction of the causative factors that would logically and physically produce such a pattern.

Engineering data extracted from aerial photography may be presented on a diversity of photographic and mapping bases, ranging from annotated contact prints to precise photogrammetric maps at a scale of 1 in.= 40 ft with a 1-ft contour interval.

The contact print is a useful base for field reconnaissance. Local conditions of terrain requiring field investigation, and access to questionable areas, are predetermined by photographic interpretation and annotated on the photograph. The same photograph serves as the base for recording the field data.

The uncontrolled mosaic, consisting of an assembly of image-matched contact prints covering a large area, serves as an effective base for regional reconnaissance. The general route and feasible alternates for pipelines, highways and transmission lines are laid out as corridors between areas presenting such major obstacles as adverse topography, wide rivers and lakes, swamps, and urban development. Within each route band, feasible general alignments are projected based on photographic interpretation of significant factors, such as critical river and canyon crossings, the rise and fall of the terrain, the drainage network, rock outcrops, and the engineering characteristics of soils, vegetation, and land use. With these data plotted on a base that shows pictorially the environmental relationships of the controlling criteria, it is possible for the location engineer to compare the various alternates and select the route with the highest level of feasibility for further investigation and refinement.

The controlled mosaic, derived from an assembly of aerial photographs that have been rectified to fit a network of plotted horizontal control,

Aerial photographs along a proposed route are being taken with a precision Wild RC-8 camera at a scale of 1:20,000. This scale is suitable for photogrammetric mapping to pipeline specifications as well as for photo-interpretation of significant terrain features for route location.

Location engineer selects the most feasible pipeline alignment by stereoscopic study of aerial photographs of the proposed route. Reference data he also consults include topographic maps of the U. S. Geological Survey, county highway maps, soil maps and reports, and geological maps.

is a semi-quantitative base suitable for horizontal and angular measurements of reasonable accuracy. This type of base is utilized principally for studies of urban areas for the planning, development, and operation of urban units and facilities. Controlled mosaics in strip form, on transparent drafting material, are finding increasing use in route location as readily reproducible bases for the planning and recording of right-of-way acquisition.

The photogrammetric map is the most versatile base for supplying the engineer with accurate measurements of terrain and cultural features. Maps showing the horizontal positions of represented features are termed planimetric maps; the addition of relief in the form of contours creates the topographic map. Photogrammetric maps to various scales and degrees of precision are utilized for final location, design and construction of such engineering projects as pipelines and transmission lines, highways, dams and reservoirs for water supply and power, sewage disposal works, new and expanded seaports and airports, and reclamation and irrigation projects.

"Engineered" aerial photography

The key to economical and efficient utilization of aerial photography lies in tailoring the correct combination of equipment, materials, procedures and personnel to the specific requirements of an engineering project to provide quantitative and qualitative terrain and cultural data. "Engineered" aerial photography starts with the determination of the optimum photographic scale that will produce the desired product. The next stage, planning the photo mission, involves the selection of the proper combination of camera, photographic materials and aircraft, and the layout of flight lines to insure complete coverage and favorable location of ground control. An experienced flight crew accomplishes the photo mission, adhering to rigid specifications which insure proper stereoscopic overlap, complete coverage, and minimum deviation from a horizontal plane. The processed aerial film is made available for field surveys to establish the skeletal network of ground control required for photogrammetric mapping.

While the field surveys are in progress, pertinent reconnaissance information is compiled by photo-interpretation techniques, and annotated mosaic maps are prepared. As ground control is received from the field, stereoscopic plotting instruments proceed with the production of the planimetric and topographic maps required for the project. Close coordination between client and contractor provides delivery of the specified maps and studies when needed.

The maximum benefit from "engineered" aerial photography is realized when the complete engineering project is developed by an organization staffed with qualified location and design engineers, geophysicists, photogrammetrists, photo-interpreters, right-of-way specialists, construction supervisors and field survey parties. Such a service is of particular value to the pipeline business, where speed of planning and construction is mandatory to minimize interest charges on invested money.

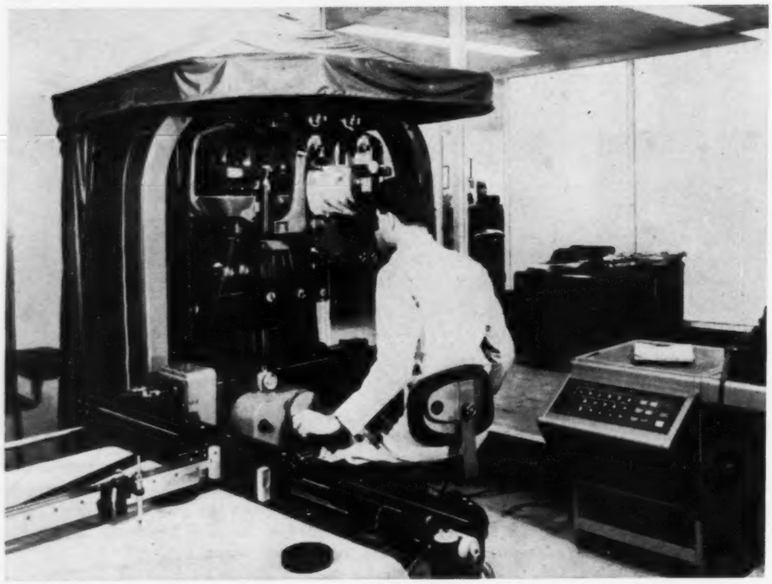
Coordinated approach

In 1960, over 18,000 miles of pipelines were either completed, under way, or under contract in the free world. For 1961, about $2.6 billion has been scheduled to be spent for the construction of over 26,000 miles of new pipelines for natural gas, crude oil and other products.

The entire development of the pipeline industry is, of course, based on the fundamental fact that pipelines are the most economical means of transporting great volumes of gaseous and fluid products from the supplier to the consumer. Economic transportation depends not only on the operating costs of the system, but also on initial construction and maintenance costs. Close coordination during the location, design and construction stages insures adherence to the economic and service criteria, and acceleration of the construction schedule.

A "turnkey" program for pipeline projects would proceed in a series of integrated stages:

1. Selection of the general route. The general route of a pipeline is based on studies of supply and demand, and controlled by major topographic obstacles between the designated terminals and branches. A detailed study of all existing maps, charts and aerial photographs in the vicinity of a contemplated route permits the selection of the general route as a corridor two to three miles wide, within which the optimum alignment can be selected. A set of maps or



Aerial triangulation by the Wild A-5 first-order stereo-plotter and digitizer extends horizontal control from the known positions of features identifiable on the photographs to selected points in successive photographs. Spatial coordinates are recorded on tape by the digitizer, and triangulation "closure" is effected by an electronic computer.

mosaics of the area bracketing the route corridor is prepared at a scale of 1 in. = 1 mile, to serve as the base for initial reconnaissance by auto and light plane, and also as the base for planning the aerial photographic phase.

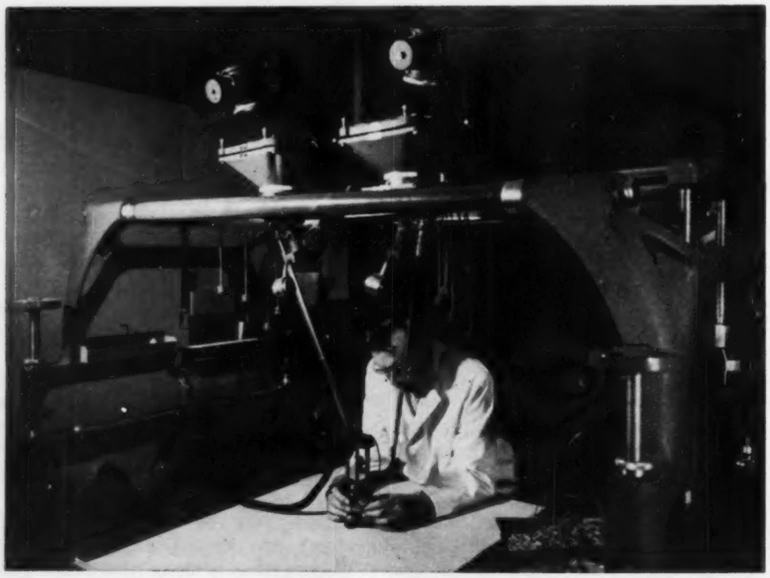
2. Aerial photography. Aerial photography of the general route is taken with a precision camera of 6-in. focal length at an altitude of about 10,000 ft above the mean terrain. Experience has shown that the resulting stereoscopic 9-in. x 9-in. photographs, which cover a strip about 3 miles wide at a mean scale of 1 to 20,000, can be utilized both for interpretation of the terrain factors influencing pipeline location and for photogrammetric mapping. Photographs to a larger scale can be obtained if necessary for congested or built-up areas.

3. Preliminary alignment. Stereoscopic examination of the photographs by experienced pipeline engineers pinpoints optimum locations for structures at critical points such as rivers, canyons, and populated areas. Detailed study of the intervening terrain permits the economic selection of the connecting portions between critical points, and the location of favorable sites for compressor and pumping stations, pipe yards and maintenance depots. Factors evaluated by photo-interpretation include accessibility, rise and fall of the terrain, occurrence of surface and subsurface bedrock, soil textures and porosity, surface drainage and depth to the water table, landslide potential, land use and land evaluation, and sources of construction materials.

The preliminary alignment plotted on the photographs represents the best compromise among the above criteria which affect construction and maintenance. At this stage, areas suspected of having a thin soil mantle over bedrock, or corrosive soil conditions, are outlined for subsequent field investigation by a geophysical team equipped with refraction seismic and soil-testing instruments.

4. Stereo compilation and mosaic preparation. Photogrammetric mapping of the route band proceeds concurrently with the selection of alignment. Planimetric maps, compiled at a scale of 1 in. = 1,000 ft, show the true horizontal positions of such pertinent features as houses, trees, pole lines, streams, ditches, fence lines, clearings, crop lines, highways, and railroads. In extremely rugged terrain where there is a scarcity of planimetric detail, relative contouring can be shown for purposes of field orientation. The route centerline, right-of-way width, and selected sites for structures and appurtenances, are projected on the strip maps. Although no dimensions or angles are noted along the selected alignment, the strip maps are accurate enough to enable the scaling of distances and protracting of angles. As these maps are compiled, they are made available to survey parties for field stake-out, and to the geophysical party for the investigation of construction conditions along the alignment and at sites for structures.

While the photogrammetric map-



Photogrammetric strip maps bracketing the preliminary pipeline alignment are compiled by the Kelsh stereo-plotter. This projection instrument recreates a measurable stereoscopic image of the terrain scaled to basic control established by aerial triangulation.

ping is in progress, controlled mosaics of the route band, at the same scale, are prepared on a reproducible transparent format designed for the planning and recording of right-of-way acquisition. All route details are duplicated on the mosaics, affording right-of-way personnel a detailed record of the selected alignment in relation to such pictorial evidence of property lines as fences, walls, tree lines, crop lines, streams, roads and trails.

5. Land acquisition and field stake-out. Right-of-way personnel, in advance of field stake-out, investigate land ownership along the projected route. With the approximate location of the pipeline preselected, title search is narrowed down to those properties actually traversed by the pipeline. Easements, options, and titles to properties are secured as required, facilitating access by field parties and the geophysical party to public and private lands. Where local requirements specify monumented title surveys tied to existing surveys as a prerequisite to registry of easements, a schedule is prepared for property surveys to immediately follow the field stake-out.

An advance team of surveyors, working closely with the right-of-way department, supply the necessary detailed surveys of highway, railroad, utility and river crossings required for permit drawings, so that crossing permits can be secured far in advance of construction. The right-of-way mosaic maps form the bases for plotting all pertinent data on property acquisition, including tract numbers or names of property owners, roddage or acreage of easement, easement and title-transfer references, and negotiated costs.

Field stake-out closely follows the right-of-way team. Survey parties are supplied with general route maps, photographs, and detailed strip maps showing the proposed location. Party chiefs, in effect, have a complete set of instruction sheets from the location engineer specifying where to stake the line. Stakes are placed at stations spaced evenly at 200 ft along the centerline, and all angle points are referenced to permit reestablishment after clearing and grading operations.

Physical features and required property ties are stationed, and astronomic observations are made as needed, to ensure the positive position of the centerline. When slight deviations from the line are warranted by field conditions, the right-of-way department is informed if the change involves new tracts of land. Detailed surveys of structure sites are made for the large-scale maps required by the design engineers. Survey data, in the form of standard field notes and annotated photographic material, is returned to the office for incorporation into the final map, and for the preparation of site maps.

6. Final mapping. The original planimetric strip maps are used as the base for plotting the field traverse and the stationing of all physical features crossed by the pipeline. With the addition of property lines and property data from the right-of-way department, the strip maps are rapidly transformed into comprehensive final maps.

7. Geophysical investigation. A three-man geophysical team, guided by photo-interpretation of terrain features, precedes the field stake-out by several days to investigate construction conditions along the proposed alignment. Refraction seismic methods are utilized to determine the presence of bedrock or boulders in the trenching section in shallow soil and glacial drift, and to evaluate the rippability of the rock. Organic soils with high moisture content are investigated for corrosive properties. Sands, silts and other unconsolidated soils that may cave during trenching are recorded. Old landslides and slopes susceptible to landslides are investigated for stability. Locations and engineering characteristics of nearby construction materials are inventoried. Foundation conditions at sites for structures are thoroughly investigated, and boring locations are selected.

The geoghysical phase of pipeline location serves three important functions: (*a*) It minimizes delay in field stake-out by predetermining areas where local changes are required in the proposed alignment. (*b*) it minimizes delay in construction by predetermining construction conditions, thereby permitting the optimum selection of equipment and techniques to lay the pipeline and build the structures; and (*c*) it supplies the location engineer with important data required for the valid estimation of construction costs.

8. Engineering design. Detailed design for structures at crossings, for pump or compressor stations, and for the pipeline, proceeds at the office as field survey and geophysical data are received. Necessary plans, specifications, and contract documents are prepared for the award of construction contracts.

9. Supervision of construction and record survey. A staff of qualified supervisors, inspectors, and construction surveyors is selected to work with the contracting organizations. The surveying teams replace destroyed alignment, establish clearing limits, lay out the horizontal and vertical curvatures of the excavated ditch for field pipe bending, furnish line and grade as needed at crossings, perform normal construction surveys at structures and pump stations, and estimate quantities of work performed as the basis for periodic payments to contractors. The supervisors and inspectors are on the job directing survey operations and overseeing the work of the general contractors to insure adherence to the specifications and construction schedules.

The "record survey," to provide final maps and plans of the line as constructed, proceeds concurrently with construction. A "rechain survey" party establishes continuous stationing in the direction of flow, positions deviations from construction plans in the location of pipe changes, installations and appurtenances, and records the inventory of all materials utilized to construct the pipeline. Conditions which affect construction costs are stationed and recorded, such as the beginning and end of rock areas, including depth of trench where excavation required drilling or blasting, and the beginning and end of rock-disposal and topsoil-separation areas.

Where field conditions during the course of construction require shifting of the alignment outside the area covered by the original survey, the aerial photography is utilized along with a field survey to reference locations of physical features removed by construction, such as walls, fences and bench marks.

The field notes, and the graphical data recorded on the construction plans and photography, are forwarded to the drafting office for review and incorporation into the final plans, to produce the "record survey" required for final contract settlement, for operation and maintenance of the pipeline, and for the substantiation of construction costs in determining the rate structure.

Thus it is evident that aerial photography offers speed and economy in securing quantitative and qualitative information on terrain and cultural features for engineering projects. Efficient utilization of the photography is secured by tailoring the correct combination of equipment, procedures and personnel to the requirements of the project. Projects with accelerated construction schedules, such as pipelines, secure maximum benefit from a "turnkey" program which closely integrates location, mapping, field survey, geophysical investigation, right-of-way acquisition, engineering design, and supervision of construction.

Pittsburgh's retractable-roof auditorium occupies 20 acres of a 95-acre redevelopment site adjacent to downtown Pittsburgh. Note the multiplicity of roads and bridges serving the area as well as the long-dreamed-of Crosstown Boulevard at left center progressing toward the auditorium.

Retractable Dome

for Pittsburgh's Auditorium

Pittsburgh's "too-good-to-be-true" dream of an all-weather summer theater, closed or open to the stars, which can become an all-season sports arena, exhibition hall, and convention center, will come true this fall when the Public Auditorium of Pittsburgh and Allegheny County opens for light opera and other events. The stainless-steel roof, the first structure of its kind ever built, is made up of pie-shaped leaves, two fixed and six retractable, the latter capable of being opened or closed in 2½ minutes.

The auditorium is in a 20-acre tract, part of a 95-acre area formerly blighted, which has been cleared by the Pittsburgh Urban Redevelopment Authority. The new auditorium (see photo above) is near the famed Golden Triangle, where the Allegheny and Monongahela rivers meet to form the Ohio. Here Pittsburgh's practical dreamers have created a most beautiful, functional and valuable parcel of waterfront property, an answer to the now well-known advice about Pittsburgh—"abandon it."

The auditorium, designed by architects Mitchell and Ritchey, will house a wide range of activities. It can serve as a convention hall, an open-air amphitheater, a sports arena or an exhibit center. The structure has excellent acoustics, modern lighting, extensive stage accommodations, a convertible ice rink and facilities for both radio and television broadcasts. It is air conditioned and can accommodate from 7,500 to 13,600 people, depending on the event. Three lots adjacent to the building will provide 1,700 parking spaces. Other lots in the immediate vicinity will accommodate thousands of additional cars.

The unique feature of the auditorium is its vast retractable roof, sheathed in stainless steel. The first such dome ever built, this roof designed by Ammann and Whitney provides a year-round weather-proof auditorium that can be converted into a spectacular open-air stadium at the press of a button. One of the largest clear-span roof structures in the world, it is nearly circular in plan, has a maximum diameter of 417 ft, and a rise of about 109 ft.

The retractable-dome roof is held by a cantilevered, curved, tripod "space frame" outside the structure. Although the legs of the tripods are made up of straight box sections, the effect from a distance is that of a curved structure, since the sections are put together with small intersection angles. The two top legs, generally in tension, are box units 3 by 3½ ft on a side, with shop-welded joints at the frame intersections. The bottom leg or main girder, always in compression, is an 8-ft x 17-ft box with a plate diaphragm at mid height, which divides it into twin boxes, each about 8½ ft square.

Welded 2 x 2½-ft box members form triangular cross frames to tie the three legs together for the lower part of the tripod. Where the legs converge, in the upper part of the space frame, cross girders with T-flanges closer to the pivot, on top of the main girders, are utilized to tie the legs together. High-strength bolts are used for field connections.

The movable roof is divided radially into eight approximately equal sections, six movable and two stationary. When the roof is retracted, the six movable sections (three on each side) will glide one over another to rest on top of the two fixed sections, thus opening the huge arena to the sky. All eight leaves are supported at the crown by the exterior triangular steel space-frame that is cantilevered from outside the dome. The entire roof structure is mounted on a circular reinforced concrete ring girder 34 ft above the arena floor.

Roof leaves

In plan, each roof leaf is a 45-deg sector of a circle, each top or leading leaf having a radius of 207 ft and weighing 300 tons.

Each of the four pairs of leaves in the dome has a different radius at the base so that the four leaves on each side of the space frame can be nested one over the other as they are retracted. The distance along the chord at the base is about 162 ft and that from the supporting rail to the pivot, measured along the curved axis of the arch, is 250 ft.

The main structural members of the leaves are radial ribs made of 30 WF beams. Each rib is composed of a series of straight sections mitered and

Supporting cantilevered "space frame" was erected with the two fixed leaves. These fixed leaves, like the six movable leaves, frame into the bearings at the top and are not connected structurally with the compression girder. The movable leaves glide, one over another, to rest over the fixed leaves.

H. REY HELVENSTON, Resident Engineer and Superintendent of Construction, Public Auditorium Authority of Pittsburgh and Allegheny County, Pittsburgh, Pa.

EDWARD COHEN, F. ASCE, Associate, Ammann & Whitney, Consulting Engineers, New York, N.Y.

butt-welded together to follow the dead-load string-polygon. The ribs are spaced about 27 ft apart at the lower edge; there are seven ribs at the bottom but three drop out as they converge so that four frame into the pivot weldment. Individually powered and braked two-wheeled carriages are placed at the lower terminus of the five interior ribs of each movable leaf to provide for motion. Each leaf is about 3 ft thick, including roof and ceiling materials.

The leaf roofing consists of Robertson 3-20-Q decking with rigid insulation and an exterior covering of stainless steel designated as type 302, finish 2-D of the American Iron and Steel Institute, of 20 and 22 gage. The leaf ribs were designed for two conditions of loading: (1) for the conventional stresses under dead load and a uniform live load of 15 psf over the entire leaf, plus a pattern load of 15 psf placed for maximum effect at the design sections, and (2) for yield-point stresses under dead load and a pattern load of 50 psf on one half placed for maximum effect, plus a uniform load of 20 psf over the other half of the roof.

A pivot weldment at the upper end of the space frame can move sideways and rotate as much as 5 deg when subjected to unequal snow and wind loadings. Transverse deflection may amount to as much as 1 ft for a 30-psf differential live load on half the roof. The pivot is expected to move toward the stage a distance of about 6 in. when the roof leaves are driven from closed to open position. Dependable controls are provided so that the leaves will remain symmetrical during movement, thus keeping unequal loading of the pivot to a minimum.

The converging ribs at the apex of each leaf join into a single pivot weldment that delivers the leaf thrust, a maximum of 350 tons through the pivot to the cantilever frame. Graphite-lubricated bronze Lubrite surfaces surround a stainless-steel spherical bearing of 18-in. diameter at the pivot. This arrangement provides for rotation or movement of the leaf in any direction without restraint. The spherical bearing is supported around a forged-steel cylindrical pin of 12-in. diameter. There are eight of these pins, framed into a heavy weldment supported by the space frame.

Contracts for construction

Nine prime contractors had major parts of the work. Since Pennsylvania law prohibits single contracts for buildings, operations were coordinated through the office of the resident engineer without direct contractural relations among the builders. It is believed that competition is encouraged when separate bids are taken for the several major parts of the work.

Well-prepared bidding documents, close cooperation among architects, engineers, consultants, owner and prime contractors, helped to keep the project moving rapidly and to hold the cost to a minimum. The office of the resident engineer is the liaison and nerve center through which all the construction negotiation and coordination are handled. Project scheduling and expediting as a whole, and contacts between contractors, also are coordinated through the office of the resident engineer.

Shop drawings from the prime contractors come into the resident engineer's office. These are processed on the job for coordination, checked in detail by the architects and consultants, then issued by the resident engineer to the several contractors—who get instructions for incorporating the pertinent work into the project.

With the exception of the additional weight of structural steel resulting from the final detailing of the complex shop-welded joints for the space frame, the cost of extras on the project has been relatively insignificant. Actually it has been less than one half of one percent of the original contract totals, an indication that work under several contracts can be economically coordinated.

Soil at the site is a hard blue shale, which can be dug by heavy machines without blasting. However, where concrete was to bear against the earth, as in the tie-back anchorages, exposed shale was gunited as soon as excavated to prevent softening. The anchorages and the base under the compression member of the space frame take a very considerable load.

Unequal snow or wind loading, or both, can cause a top leg to be in

Ring girder, which supports the leaves, was concreted in sections of $7^1/_2$ deg of arc, supported on pipe scaffolding. Some 5,000 bolts to hold the rails were accurately set in a shop-fabricated template built into the form.

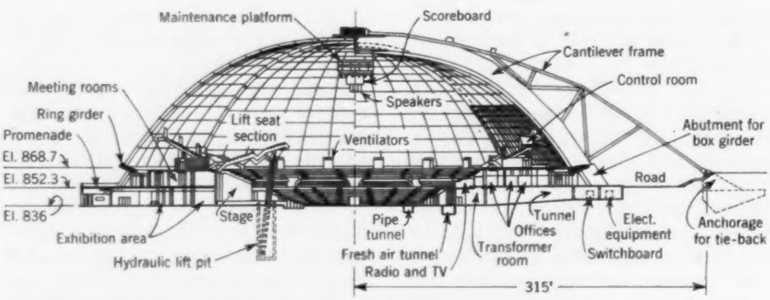


FIG. 1. Cantilever space frame supports the eight leaves of the roof in open or closed position. Note seat section that is lifted to provide a long stage.

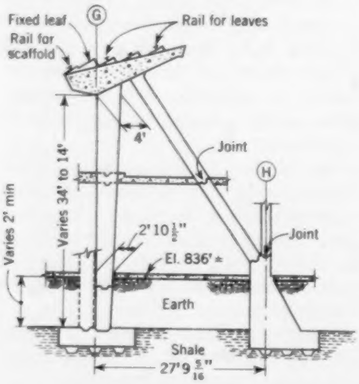


FIG. 2. Elevation of A-frame supporting the ring girder.

some compression. The real work of each top leg, however, is to transmit pull to the reinforced-concrete tie-back anchorage. This anchorage has a sloping bottom, large shear keys or ears, and a large vertical face of hard blue gunited shale to push against. Twenty-four special steel bolts of 2½-in. diameter and 21 ft long, in embedded plate frames, transmit tension to reinforced concrete tie-back anchors through cages of reinforcing bars, positioned in structural-steel frames, which are anchored to the hard blue shale below. Double nuts are welded to the bottom end of the sloping anchor bolts, and to the under face of a heavy anchor plate, which also positions the reinforcing bars.

The main box girder, or backbone of the 1,500-ton space frame, is supported by an abutment with an almost rectangular combined footing 9 ft deep, which transmits its thrust to the vertical hard-shale faces of the excavation. Above this is a vertical shaft, concreted in two lifts, which partially follows the contour of the embedded base of the main girder. The reinforcing bars around the base of the girder were so closely spaced that careful planning was necessary to provide a place from which men could operate concrete vibrators in the multiplicity of chutes and "elephant trunks."

Placing the concrete ring girder and setting the rails on it was the first "hump" to be crossed in the construction schedule. This reinforced concrete unit, a quarter of a mile around, was built in typical pours of more than 100 ft of arc. Each of these 7-deg 30-min of arc sections of ring girder is supported by three solid A-frames and a split-leg A-frame at each end of the continuous section.

To give the frames lateral support, the promenade deck on the second level, called the podium slab, was placed integrally with the vertical columns in four-bay arcs with a 30-deg central angle. However, there is a complete circumferential expansion-contraction joint in the podium slab at the interior face of the vertical column, thus separating the interior and exterior concrete construction. Robert A. Zern was the consulting engineer for the interior work. The inclined legs of the A-frames (Fig. 2) are independent of the promenade deck to allow for differential movement of the structural elements due to loads from the roof leaves rolling on the ring girder.

The accurately made plywood forms were supported on tubular scaffolds and used 12 times to place the concrete for the ring girder. Some 3,000 cu yd of concrete were placed in the three space-frame foundations in seven operations.

Concrete was supplied by transit-mix. Work was continued during the winter, the temperature being maintained by oil-fired salamanders which spread heated air under forms insulated with rock-wool. Tarpaulins were hung around the ring girder to retain the heat.

High early strength cement was used for the ring girder (except for the last sections) to produce the required strength to permit early release and reuse of forms. The ring girder was concreted using two cranes with buckets.

Radial and circumferential reinforcing of the ring girder are quite

heavy to support the concentrated rolling loads from the roof leaves. The ring girder is designed for circumferential continuity in four-span sections. Torsion within the ring girder, caused by the fact that the rails for the three moving leaves on each side are on a different radius, had to be resisted. Expansion joints are located at every fourth or "split" A-frame. Movable joints in each rail allow for differential movement of rail and concrete.

Dick Corporation of Pittsburgh executed the foundation and reinforced-concrete contract.

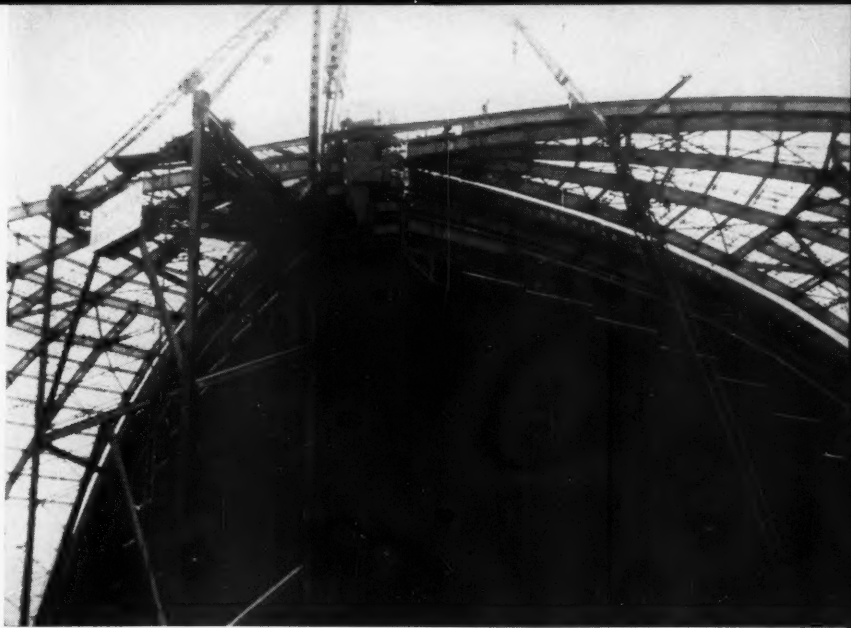
A most interesting part of the construction was the setting up of the space frame and the roof leaves. A stiff-leg derrick on a tower 125 ft high was the major unit used for erection. The space frame and fixed leaves of the roof were erected first. Structural legs supported the members until they could be tied in at the top so that the frame could take the unbalanced load. Crawler cranes assisted the derrick in steel erection as high as they could reach.

Each leaf was erected independently of the preceding one, by first setting the wheeled carriages on the rails and then building up to tie in to the spherical bearing at the top.

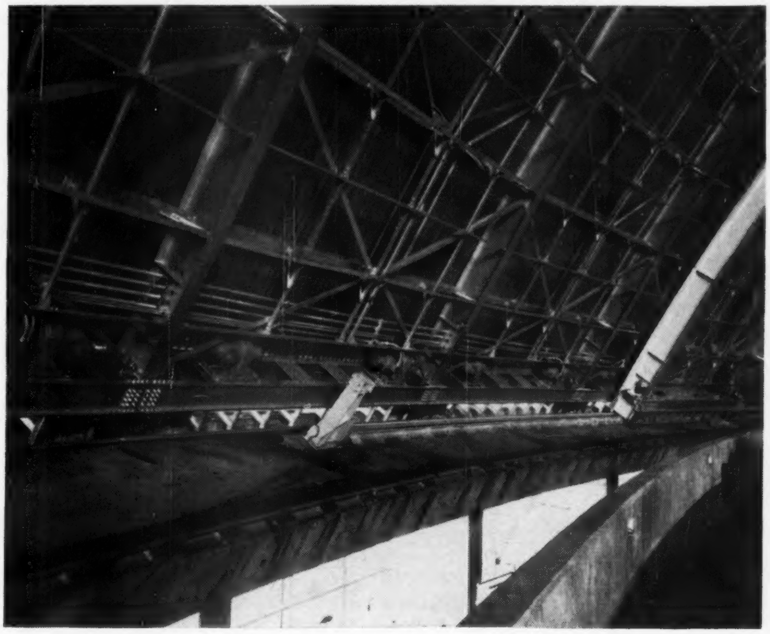
No construction equipment was more important in the work on the auditorium than the pair of pie-shaped rolling steel scaffolds conceived by the steel erector, the American Bridge Division of U. S. Steel Corporation, as an alternative to what would have been a forest of tubular scaffolding. The use of vertical scaffolding for the general support of the roof during construction would have prevented other work from being done by several prime contractors.

Originally, many parts of the structure were grouped for bidding with the roof structural steel. These included the roof deck, roof closures, sheet-metal ceiling, roofing insulation, drives and controls for the leaves, scaffolding for use in installing electrical work in the leaves, as well as the acoustical ceiling and the main ceiling. Closures, roofing and electrical drives were separated from roof structural steel before bids were taken for the work.

Immediately after bidding, American Bridge proposed the use of a rolling scaffold, which would require an extra rail on the ring girder. In plan the scaffold for each half of the roof ceiling covered two sectors, equal to one third of the area of one roof leaf; then 5 ft was added to each side of the scaffold for the safety of workmen, for stairways and the like. An



Four leaves, and the rolling scaffold, are connected through a spherical bearing to each side of the weldment held by the space frame. Dark strip at center is the compression member of the frame.



Detail at bottom of leaves shows gear motors, brakes, and bumper for travel limit of the inside leaf. Rail at right is temporary, for scaffold support.

extra pivot, with less elaborate bearings, was provided at the bottom of each side of the pivot weldment at the upper end of the space frame. The two sections of scaffold were always kept in symmetrical position with respect to each other to avoid an eccentric load on the space frame.

The rolling scaffold was designed for use under the fixed leaves, which have the smallest radii. Metal decks were provided at 8-ft vertical intervals. The working contour of the soffit of successively higher leaves was reached by increasing the height of the tubular scaffolding, supported by wood plates on the metal deck floor. Wood scaffold plank topped off this working platform. Design of the moving scaffold was based on dead load plus 50 psf for men, light tools, and materials.

Electricity on the scaffold, for temporary lighting and small power tools, was furnished under the electrical contract. The electrical contractor and the ceiling subcontractor worked in harmony on the scaffold, doing some operations alternately and others simultaneously as needed. When need for

The fixed leaf at left, next to the space frame, and the movable leaf next to it, have been covered with stainless-steel sheets. The right half of the movable leaf is covered with Robertson Q-deck as left by the steel erection contractor, American Bridge. The next steps are the placing, by Limbach Company of Pittsburgh, of a vinyl sheet as a vapor barrier, Koppers Wolmanized treated wood nailers, fiber-glass insulation, rolled saturated felt, aluminum gutter bars, and a final topping of stainless-steel sheets.

the scaffold is over, it will be partially supported from the floor by falsework while a long-boom crawler-crane lowers sections as they are burned off.

The cost of designing, fabricating, erecting and dismantling the rolling scaffolds will be in excess of a quarter of a million dollars. Despite this, considerable time and money were saved over any alternate method of applying the ceiling and installing the electrical equipment on the leaves. These rolling scaffolds have facilitated the handling of all materials. Also, they have added greatly to overall safety on the job.

The work on the outside of the dome proceeded somewhat ahead of that on the inside, conducted from the scaffolds. The above photo shows in

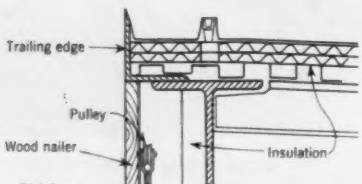


FIG. 3. Detail of closure at curved edges of retractable leaves.

the center an unfinished leaf. On the right half of this leaf, zinc-coated Robertson Q-deck, with flat galvanized flashing covering radial areas above two inside leaf ribs, can be seen. This is the condition in which American Bridge and its subcontractor left the roof. At this point the Limbach Company of Pittsburgh took over to cover the Q-deck with an adhesive and smoothly lay a red vinyl sheet, which serves as a vapor barrier. Over this sheet, Koppers Company Wolmanized pressure-treated wood nailers are placed. These are carefully set in mastic and fastened with stainless-steel sheet-metal screws into the roof deck. Between the wood nailers are placed almost rectangular sections of thick fiber-glass boards, which fit closely into the nailers and come flush with them on top.

Over the top of this curved surface is placed rolled saturated felt held by an extruded aluminum gutter bar, which is screwed into the wood nailers with aluminum screws, and covered with stainless-steel sheets. After these bars have been checked for alignment and watertightness, a rolled stainless-steel batten cap is fastened down with stainless-steel screws and neoprene washers. In the above photo these boards have been placed part way up the left side of the unfinished leaf.

Near the top, where the tangent to the roof curve is nearly horizontal, the stainless-steel sheets are not fastened with battens but are welded by the Heli-arc process using inert argon gas. This provides a large waterproof pan at the top, where drainage would otherwise be a problem.

An important feature of the permanent structure is the electrical drive for the retractable roof leaves. Functional performance specifications and operational criteria were provided for bidding purposes and included d-c and a-c powered roof-drive alternates. Bidders' ingenuity and choices were encouraged. The roof control and drive systems, which were the responsibility of Ammann & Whitney, were added to the electrical work, to be bid under one contract. All other electrical work was designed by the Pittsburgh electrical consulting engineer, Carl L. Long Associates, who were responsible for the project electrical installation except for the roof-drive and control system.

In the bid for electrical work, the contractor offered a considerable saving if the a-c alternate for drives was accepted. Substantial as this saving was, it was a lesser factor in the decision than two others. Since the roof leaves will not be moved during several winter months, the a-c motors without commutators would involve less maintenance than would dirty or oxidized d-c and arcing commutators. This is an important factor when considering the cost of replacing or dressing down the paneled-in and sloping motor commutator for a roof leaf. Important too are the new Westinghouse Mag-Amp controls, based on reactors, controlling the feed of a-c power to the gear motors. These controls are an outgrowth of the system used on the nuclear-capsule cranes at nearby Shippingport, Pa., in the first commercial atomic energy electric power plant.

Typical of many items in the complex of interlocking contracts is the chain of purchasing for this electrical equipment. The owner let the contract to E. C. Ernst, Inc., who worked with the fabricator of the trucks and with the motor and control-system manufacturer. Heyl & Patterson, Inc., supplied the welded-wheel assemblies, including the Westinghouse gear motors, brakes, buffers and limit switches. Westinghouse furnished the elaborate interlocking control system utilizing the Mag-Amp reactors. All of this went to electrical contractor Ernst, keeping the responsibility in one line. The system, approved at every step by Ammann & Whitney, was superior to what might have been rigidly specified on a non-performance basis at the time the bidding documents were prepared.

Incoming power at 22,000 v leaves the transformers at 4,160 v. From switchgear, power is distributed by underground conduit, to utility tunnels in conduit. Conduit in the tunnels provides a route to one 900-hp motor for driving the larger air-conditioning water chiller, as well as to six

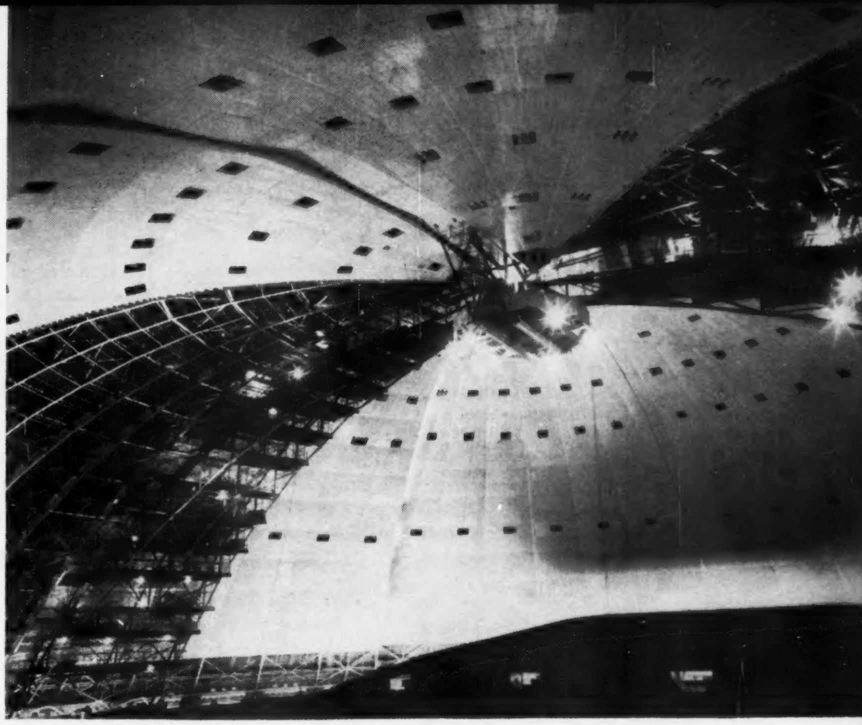
power centers throughout the structure. One power center, in the Roof Electrical Equipment Room, provides distribution to the roof lighting panels on the platform at the apex of the roof. Another power center, in the main mechanical room, feeds all but one 900-hp motor there and also feeds the reactors (in the Roof Electrical Equipment Room), which control the power to the roof-drive motors.

All power for the roof, taken up through the main compression girder to the apex, is conducted through a multiplicity of insulated cables. For each roof leaf, power is carried through a hanging loop, sheathed in a synthetic rubber "fire-hose," which is then attached to conduit bends at the apex of each leaf (just back from the pivot). Conduits fanning out from junction boxes at the top of the leaf are installed along the leading edge of the leaf framing, in the "outside" sector; they lead to lighting fixtures, and to the roof leaf-drive motors and their controls. Other systems distribute power for stage lighting, escalators, air conditioners and the pump of the hydraulic system, which motivates the lift seat section.

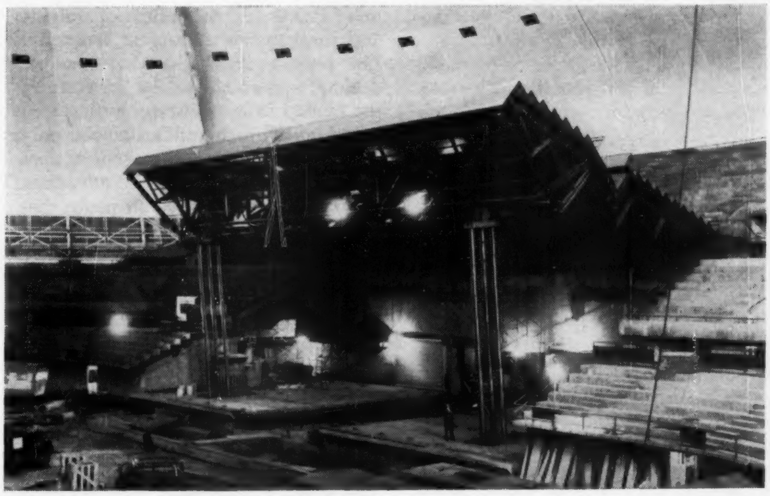
By early June it is expected that: (1) the roof will be weathertight and movable, (2) the rolling scaffold will be dismantled, (3) concreting will be completed for the ice rink, (4) installation of the upholstered seats will be well along toward completion, and (5) the decorative exterior concrete and planting will be completed. In general all operations will be proceeding at punch-card speed to complete the structure for formal opening in September.

There has been excellent cooperation among the forces of all the contractors, architects, engineers and owners on the project. A major factor in this has been the job communication system. There are six telephone sets on each of three different trunk lines so that three independent job conferences can proceed simultaneously. These might involve numerous out-of-town consultants, manufacturers and fabricators and several of the job personnel. In addition there is an autocall system and an inter-communication system. All this centers in the office of the resident engineer, where the job is coordinated.

In the course of the job there have been minor differences among field forces who wanted this or that done "now" or needed more space to work. But a team atmosphere was generated and has now brought close to completion this unusual structure in which the engineering-construction fraternity can take pride.



Key to economical erection was a rolling scaffold one-third the width of a leaf plus 5 ft on each side. The scaffold rolled on a temporary rail on the inside of the ring girder and was held at the top by a spherical bearing added to the leaf-support weldment.



A section of the auditorium can be raised 36½ ft to form a stage 118 x 64 ft. Hydraulic lifts, furnished by Dover Corporation Rotary Lift Division and installed by Marshall Elevator Company, handle the 445,000-lb seat section on 12 5/8-in. plungers 45 ft long, with hydraulic pressure at 1,000 psi. For arena events this section is lowered to permit use of the centrally located seats.

Decimal system, YES

metric system, *no*

BERNARD L. WEINER, F. ASCE

Steinman, Boynton, Gronquist & London
Consulting Engineers
New York, N. Y.

There should be no doubt in anyone's mind that a decimal system of weights and measures is an urgent necessity. The only question is—what kind of decimal system should be adopted by the United States? Discussion has been based on the assumption that the only choice is between the present system and the metric system. The advocates of the latter have failed to prove that it is efficient in any respect other than that inherent in any decimal system. This point seems to have been ignored. Insufficient thought has been given to the practical matter of reducing to a minimum the disruption that is inevitable during any such change-over.

Change is not necessarily progress. And in most fields, changes are made without adequate study, or even any study at all, of the reasons for the development of things as they are. Had such a study been made of the so-called English system of feet (not yards) and pounds, it is extremely doubtful that the metric system would have been adopted even by the French. Since it was George Washington who first presented the metric system to Congress (and it still hasn't been adopted) perhaps Americans have had an instinctive repugnance to it because of its artificial nature.

Meter has an arbitrary basis

The meter is based on a purely arbitrary consideration, that is, a ten-millionth part of the estimated length of the earth's meridional quadrant, which equals approximately 39.4 inches. Similarly, the kilogram is an artificial unit. It is defined as the weight of a cubic decimeter (named a liter) of water under certain "standard" conditions. This weight is about 2.2 pounds. Hence it is extremely unlikely that either unit will prove to be efficient in practical use.

There is no practical reason for either definition other than certain claimed advantages which, though real enough, are neither the result of these definitions nor inherent in the metric system exclusively. These advantages can be made to apply to other units of weights and measures. Thus this argument for the metric system fails to convince.

The late Shortridge Hardesty, F. ASCE, once said that the American advocates of the metric system are confused: what they really want is a decimal system. And there should be no need to belabor the point that a decimal system of weights and measures is an urgent necessity. The loss of millions upon millions of man-hours—wasted because of the unnecessary barnacles that have encrusted the English system—must be stopped. But it is not necessary to tear down the house just because a few minor, though very important, repairs are needed.

A system—any system—for everyday use by average persons should be geared to the keenness of our senses, to our physical make-up, and to our relation to the physical world. As Mr. Hardesty pointed out, it is no accident that ⅛ in. is the smallest unit of length that the artisan uses or needs. The pound is no accident either. For in-

stance, the housewife (who is a very important person to be considered) finds the pound a practical unit for buying butter or anything else. The kilogram is too big—a kilogram of tobacco would be enormous. These units are the result of the keenness of our senses in relation to the physical world. Simple and trivial as this may seem, it is a most important and vital consideration.

Mr. Hardesty also pointed out that fortunately, for most practical purposes, ⅛ in. is equal to 0.01 ft. Therefore the foot unit is better than the meter—for a smallest working unit, the millimeter is too small and the centimeter is too big. For more precise work, 0.001 ft is small enough but the millimeter (3.3 times as much) is too large. Thus the metric units are either large or small in the wrong places.

Having worked in the metric system to the extent that he was thinking in it, the writer found that detailing in metric units was very awkward. This is to be expected of an artificial system.

Avoid disruption in change-over

Furthermore, if a change is to be made it should be made with the least possible disruption during the change-over and with the least possible disturbance to familiar concepts. If the benefits that are the goal can be achieved by more or less minor modifications of an existing system, it makes good sense to do so. It is admitted by the advocates of the metric system that the change-over is difficult; they therefore recommend that it be made in somewhere between 20 to 33 years. Modifying the English system to obtain the benefits of a decimal system could, in most instances, be done practically overnight.

As far as length is concerned, the change has already been made. The engineer uses tapes that are graduated in feet, tenths and hundredths. As a further aid, let us retain the word "inch" but redefine it as one-tenth of a foot. The "inch" is a useful unit in many fields, and there is no reason for discarding it even though it now becomes a bigger but more sophisticated inch.

Mr. Hardesty has referred to the "engineer's scale" as a bastard scale—it divides the foot into inches (twelfths), which in turn are divided into tenths, twentieths, etc. Using the new inch, we immediately have a decimalized natural scale; 1 in. = 10 ft would mean 1 : 100 instead of 1 : 120, etc.

Incidentally it is interesting to note that the present method of designating reinforcing bars by number will remain unchanged and with the same values.

Furthermore, in consideration of the practical value of causing as little disruption as possible, the present inch, $\frac{1}{12}$ ft, can be retained but renamed a "timber-inch" for the lumber industry so that the 2 x 4, for instance, will remain the same 2 x 4 without change. This suggestion is not a contradiction, nor will it involve any additional computation. The 2 x 4 is only a nominal size anyway and adjustments must be made even under the present system, where the actual size must be considered.

The pound needs no change

The pound need not be changed. Here again, "decimalizing" has already been accomplished—the "kip," equal to 1,000 lb, is already in common use by engineers. Nor do fractions of a pound present a problem. Furthermore, the supposed advantage of the kilogram and meter relationship to specific gravity is purely imaginary. It is difficult to understand why the concept of specific gravity was adopted in the first place. Why relate the weight of a material to water at all?

Why look up the specific gravity of a substance and then multiply it by 64.2 pounds to get the weight per cubic foot? Let us look up the weight per cubic foot to begin with—handbooks give both, side by side. We thus have a "natural specific gravity" or "specific weight" based, not on any artificial definition, but on gravity only. Hence, one of the claimed advantages of the metric system becomes meaningless—using a "natural specific gravity" or "specific weight" makes the fact that a liter of water under "standard" conditions weighs a kilogram entirely trivial.

The gallon can also be decimalized. A gallon is now defined as 231 cu in. Let us redefine it as 173 cu in. or ¾ of the present gallon. This requires no violent change in concept—the Canadian gallon is ¼ more than the present U. S. gallon and no American ever became excited over it when motoring in Canada. But if we use the new "inch," equal to $\frac{1}{10}$ ft, the gallon then becomes $173 \times (10/12)^3$ or 100 cubic "inches." A quart will still be defined as ¼ of a gallon, and is about the volume of the present *fifth* so widely used in the liquor industry (0.187 as against 0.200). A cubic foot, incidentally, becomes 1,000 cubic "inches," which is equal to 10 "gallons." Very convenient, indeed, and the old familiar tools, modernized in some very important respects, are still with us.

These easy-to-understand and easy-to-make changes immediately free us from the drudgery of using such handbook crutches as Smoley and Inskip, and tables of decimal equivalents.

International trade

The argument that the United States is at a disadvantage in international trade because 90 percent of the world's population is either using the metric system or is in the process of changing to it can be disposed of easily. If the figure of 90 percent is a fact, it includes the hundreds of millions in Asia, in Africa—in short, in the undeveloped countries where a system of weights and measures is as yet of little importance. It would involve infinitely less trouble for them to change back than for the United States and England to change to the metric system.

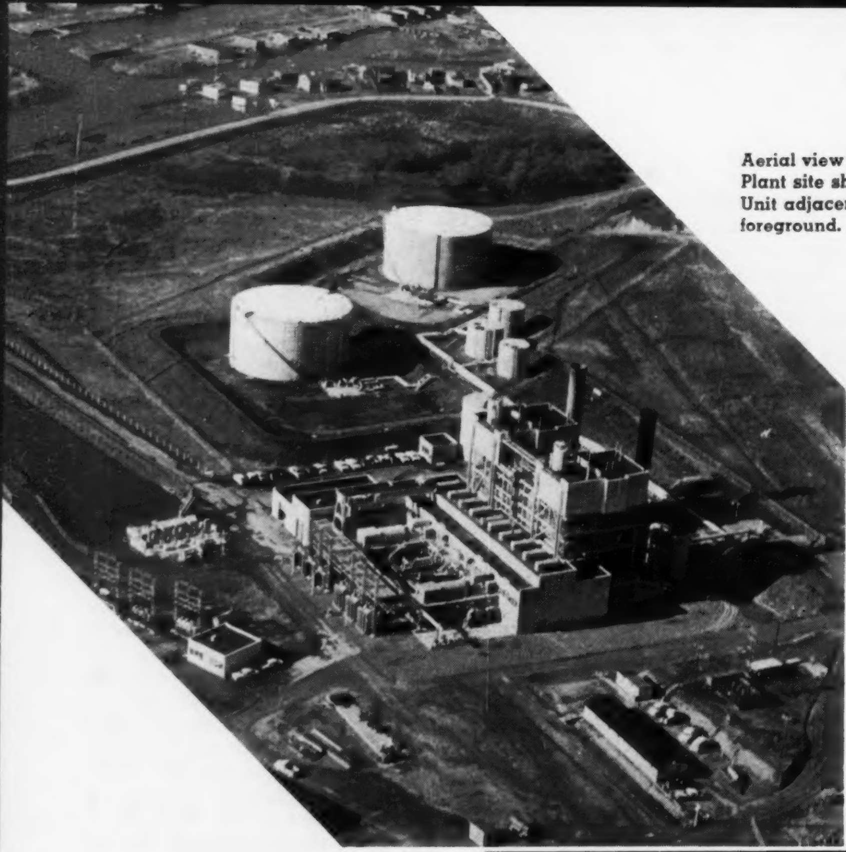
It is also doubtful that the United States really suffers in international trade from the fact that, internally, it does not use the metric system. We can still sell goods in terms of long tons, cubic meters or whatever may be necessary. The solution of the problem of international trade lies in other fields and we need not concern ourselves with it here.

In passing, it might be noted that even in France, the native country of the metric system, fractions are no doubt being taught. The science of numbers is still an important one and cannot be abolished by a mere system of weights and measures.

Advantages now

If we decimalize the English system, we will reap all the advantages claimed for the metric system and more; we will have them now—not twenty or thirty-three years hence—almost painlessly. There will be little trouble in teaching the artisan how to use the new methods. The writer had no difficulty in explaining, and a carpenter foreman had no difficulty in using, the engineer's rule with ten "inches" to the foot. Using mental arithmetic, the writer had, of course, converted the inches and fractions on the carpenter's plan to decimals of a foot. And this happened under rather difficult conditions —while standing on the bottom of a mud hole in two feet of ice-cold water.

Other changes or "decimalizing" of the English system readily come to mind. But there is no need to elaborate further. It should be obvious that an *efficient* decimal system can be achieved without any violent changes in familiar concepts.



Aerial view of existing Humboldt Bay Plant site shows area for the Nuclear Unit adjacent to near end of plant in foreground.

features new type of reactor containment... pressure suppression

NUCLEAR POWER PLANT

F. F. MAUTZ, M. ASCE
Supervising Engineeer
Department of Mechanical Engineering
Pacific Gas and Electric Company
San Francisco, Calif.

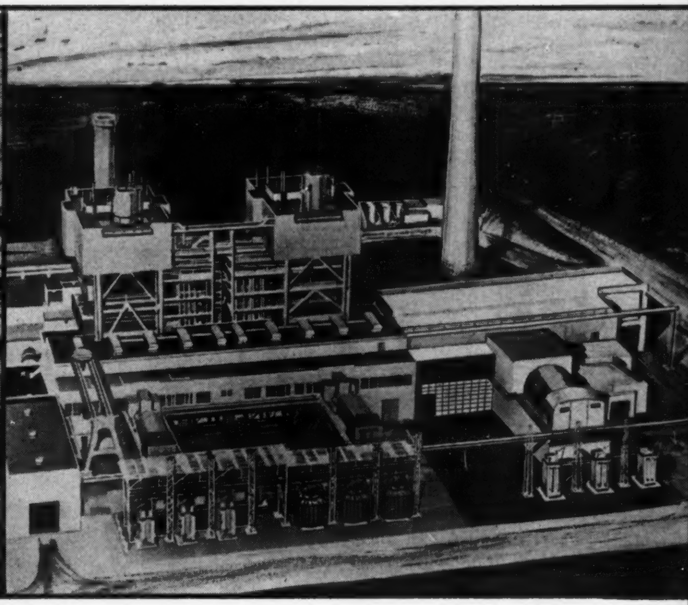
The Humboldt Bay Power Plant in northern California marks a significant advance in nuclear plant technology. Humboldt Bay will have a new system of reactor containment called pressure suppression to contain its 60 MWe (megawatts-electrical) boiling water reactor. Built completely underground, the pressure suppression system substitutes a dry well and a connected condensation tank, partially filled with water, for the dome or capsule that has been used to contain a number of earlier nuclear power reactors. The system is designed to catch —and suppress by condensation— steam which may carry escaping radioactivity that might be freed from the reactor system in the unlikely event of an accident.

Through the years station designers and equipment manufacturers have made significant cost reductions for conventional steam power plants by simplifying design, by lowering manufacturing costs, by increasing the size and efficiency of individual generating units, and by learning to use materials more effectively. It was only natural that as designers with this background began working on atomic plants, they were impressed by the relatively high cost of reactor containment, and began thinking of ways and means by which it might be reduced. The containment system demands special consideration since it must be adequate for any credible accident and low enough in cost to make nuclear power competitive with conventional power—if that is the objective.

A concept of reactor containment that showed promise of reducing space needs and plant cost provided for the quenching of escaping steam in a water pool, thereby limiting the pressure rise and permitting simpler plant design. Pacific Gas and Electric Company became interested in the potentialities of this scheme, described as pressure suppression. After preliminary studies had indicated the

In aerial view, pressure-suppression containment caisson is seen with forms stripped, ready for sinking. Concrete is placed in lifts of about 15 ft. Caisson is sunk after each lift and before forms are placed for the next lift.

Artist's concept of completed nuclear unit adjacent to existing conventional plant is marked by absence of usual dome or capsule for containment. Pressure suppression system is built completely underground.



possibility of reliable containment at a considerable saving in cost, the company decided to finance a research and development program to determine its feasibility and design parameters.

Extensive tests made

After extensive study and test work to prove the value of the concept, a design for the pressure-suppression method of containment was accepted by the AEC and its Advisory Committee on Reactor Safeguards. This method is an integral part of the Company's Humboldt Bay Nuclear Unit.

The advantages of this type of containment made it possible to locate the nuclear unit alongside a conventional steam unit as if it were another conventional unit—thereby permitting additional cost savings. An aerial view of the existing plant and site is shown on the facing page, while an artist's version of the completed plant is seen above, at right.

Total containment of a nuclear power plant must provide protection against operating accidents, such as possible failure of a reactor vessel or connecting steam or feedwater lines, and non-operating accidents, which might occur when the reactor is open for maintenance or refueling.

At Humboldt Bay, non-operating accidents will be contained within a fuel handling building located directly above the reactor containment structure. This building will be maintained under a slight negative pressure at all times. In case of any type of accident the air within the building, and its contaminants, would be passed through clean-up equipment to a stack 250 ft high and so to the atmosphere under controlled conditions. Aside from these features there is nothing unusual or novel about this part of the plant containment system.

Pressure-suppression containment will provide protection against an operating type of accident, and it is this system that includes the novel design features. The principal components of this containment system are a dry well, vent pipes, and a suppression chamber, as shown in Fig. 1.

With the pressure-suppression type of containment, in the event of an operating accident, such as a pipe break within the dry well, steam or a water-steam mixture would be discharged into the dry well, from which it would flow through vent pipes into a water pool in the suppression chamber, where it would be quickly and completely condensed. Whatever limited fission products from the reactor core might accompany the steam would go with the steam to the pool, where all except noble gas fission products would be almost completely absorbed. Fission products not absorbed in the water would pass slowly through any imperfections in the suppression chamber roof to an essentially gas-tight refueling building. Of the fission products that might be released later by

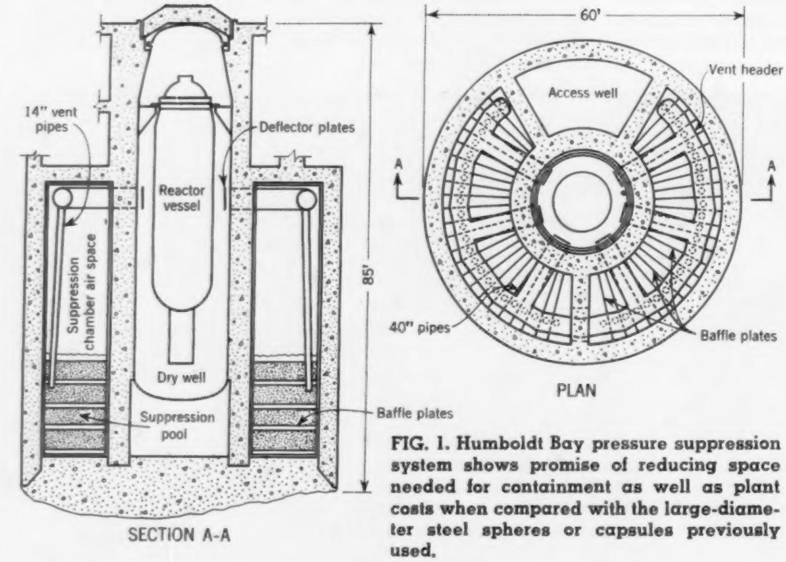


FIG. 1. Humboldt Bay pressure suppression system shows promise of reducing space needed for containment as well as plant costs when compared with the large-diameter steel spheres or capsules previously used.

fuel melting, a small fraction could leak from the dry well into the refueling building.

Basis for design

The pressure suppression containment system protects against a maximum credible operating accident (MCOA), which for Humboldt Bay is defined as a near instantaneous rupture of the main steam line of 12-in. diameter (the largest pipe connected to the reactor vessel), followed by melting of the fuel and release of fission products. This system design is also adequate for an equivalent break area in any location in the reactor vessel itself. This is not to suggest that a reactor vessel break of such an area or any other specific area is credible, but this design basis provides a margin over any possible limited damage in the form of cracks at seals, nozzles, or elsewhere. Containment provision for accidents worse than the maximum credible is not required and no representation is made that the containment system provides such protection. Accidents greater than the maximum credible would, however, benefit from whatever design margins there are in the structures and the inherent advantages of the pressure suppression system itself.

The reactor vessel is in a dry well which is a steel pressure vessel backed by concrete. Six 40-in. pipes connect the dry well to a 40-in. equalizing vent header in the suppression chamber which nearly encircles the dry well. The 40-in. pipes are protected from possible missiles by deflector plates 4½ in. thick which also help to prevent unbalanced flow. Projecting downward from the vent header are forty-eight 14-in. vent pipes which end 6 ft below the operating level of the water pool in the suppression chamber. Baffle plates separate the pool into 48 segments each containing one vent pipe. Pipe penetrations into the reactor vessel are isolated by double valves welded in tandem and located outside the dry well. The body of the first valve is connected with a shroud tube which is an extension of the dry well.

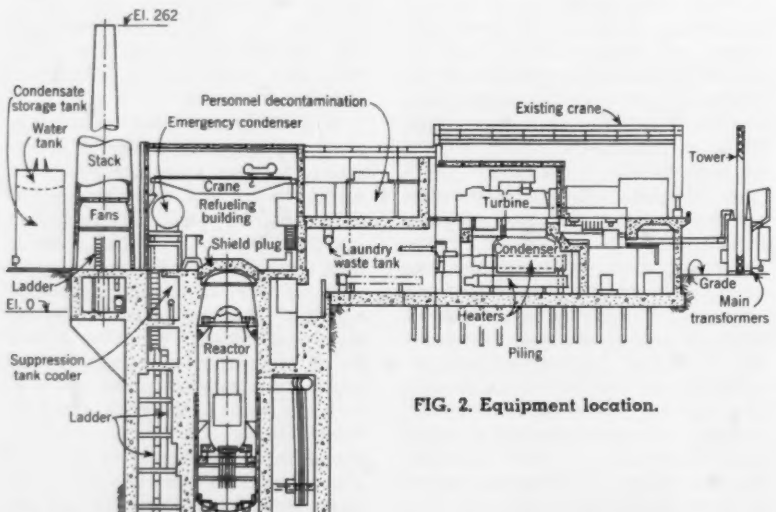


FIG. 2. Equipment location.

Test program

The Humboldt containment design is based on an extensive research and development program which cost about $400,000. Exclusive of this program and related costs, the pressure suppression design is estimated to cost about $650,000 less than conventional containment structures.

The overall test program included model tests to a scale of 1:10, full flow condensing tests, and full-scale testing of one of the 48 segments that will make up the Humboldt containment system. The latter was conducted to check scaling factors and to demonstrate that the Humboldt design would function as predicted. The facility as tested consisted of a reactor vessel and a dry well (both 1/48th of the Humboldt Bay design volume), one full-size vent pipe (of 14-in. diameter), and a full-size segment of the suppression chamber and pool associated with one of the 48 vent pipes. Transient tests were conducted with initial water and steam pressures in the reactor vessel at 1250 psig.

Maximum pressures during the transient in the full-scale test of the 1/48th portion of the containment system were recorded for comparison with values used for design. In the suppression chamber the highest test pressure obtained was 9.3 psig compared to the design value of 10 psig. (Because of other design considerations, the Humboldt suppression chamber is adequate for an internal pressure test of 24.8 psig with normal working stresses.) For the dry well, the highest test pressure obtained for the MCOA break size was 36 psig whereas the design pressure was 72 psig. The apparent lack of agreement resulted from the very conservative assumptions made in the design for the value of the orifice coefficient for

a flashing water and steam mixture.

The full-scale test confirmed earlier model and condensing test results and design calculations and led to acceptance by the AEC Advisory Committee on Reactor Safeguards. The series of tests yielded data valuable also to other plants for which this method of containment may be suitable.

Design and construction features

The reactor containment will be located entirely below grade and will comprise a dry-well vessel housing the reactor and a suppression chamber located concentrically around the dry well. The necessary space for these facilities will be provided inside of a reinforced-concrete caisson 59 ft 6 in. in diameter, sunk to an inside depth of 78 ft below grade. The location of equipment is shown in Fig. 2.

The dry well will be a steel vessel designed in accordance with the ASME Code, Section VIII, for a pressure of 72 psig. The reactor vessel will be suspended by rods supported on brackets fabricated as part of the dry-well vessel. The vertical sides of the dry-well vessel will be in contact with concrete backup all around so as to resist the potential concentrated loading resulting from steam escaping with jet force as a result of a pipe rupture.

The top and bottom heads of the dry-well vessel, which are not backed by concrete, utilize a 150-psig design for steel thickness and in addition have at least 12 in. of concrete placed inside the heads. This serves to distribute a jet loading over a larger area of the steel plate so that the plate will not be overstressed.

The suppression chamber will be of concrete lined with carbon steel, designed to contain a pressure of 10 psig in the air space above the 18-ft depth of water. The steel liner will prevent leakage both into and out of the chamber.

A 60-deg portion of the annular space otherwise occupied by the suppression pool will be utilized as an access shaft and equipped with a manlift to provide access to the bottom of the dry well. There will be access openings both at the top and at the bottom of the dry well. Two safety exits from the caisson also will be provided. One will extend the length of the caisson, with access from each floor elevation, and will terminate at an open area near the stack. The second safety exit provides direct access to the refueling building from compartments in the clean-up and shutdown systems.

The top of the suppression chamber will be about 25 ft below grade. The space above the chamber and around the dry well will be occupied by auxiliary equipment, pipeway, and new and spent fuel storage. Biological shielding will be provided throughout as required.

Since the Humboldt Bay Plant is in a region considered to be relatively active seismically, earthquake design requirements are an important consideration from the standpoint of containment reliability and cost. As the pressure suppression containment structure is completely underground, earthquake forces make up only a small part of the total structural design problem.

Earthquake design

In the work of C. F. Richter on *Seismic Regionalization for California,* showing zones of probable maximum intensity of earthquakes on the modified Mercalli scale, values of VIII and IX were assigned to the Eureka area. Intensity IX has been assigned to the coastal area of unconsolidated ground around Humboldt Bay and intensity VIII to the adjacent terraces. Geological investigations show that Buhne Point, where the plant is located, is a continuation of the terrace deposits. A study of the subsurface borings confirmed that the plant is located on this type of material and not on the unconsolidated materials or muds around the bay.

For this reason a value of intensity VIII was assigned to the plant site. Because of the nature of this project, a conservative earthquake design criteria of 25 percent dead load, or 20 percent of the sum of the dead load plus half the live load, whichever is the most severe, was adopted. The dry-well pressure vessel and concrete backing walls are designed for the pressure, temperature and jet force due to a primary system break. Temperature and pressure contribute 75 percent of the design load and the jet force contributes 25 percent. The seismic force would be less than 10 percent of the sum of the foregoing design loads. The suppression pool is designed for an internal pressure of 10 psi. Its external design pressures from the hydrostatic forces of ground water vary from 10 psi at the top to 33 psi at the bottom. Again the external seismic loads are very small. They would be equivalent to 30 percent of the top load and only 10 percent of the bottom load.

Advantages of pressure suppression

Pressure suppression containment was selected and developed for Humboldt Bay Unit No. 3 because it offers several advantages:

1. It is a simplified, less expensive design than conventional dry containment.

2. Its smaller physical size makes its location below ground economically feasible, an arrangement that affords added support for the structures and provides a radiation shield in all directions except overhead. Maximum exposure to any person on or near the site would be well within the acceptable range for the maximum credible operating accident.

3. Energy released in the event of an accident would be quickly absorbed by quenching action in a water pool.

4. Fission products would largely remain in the small volume of the dry well in the event of a maximum credible operating accident. This would greatly limit the spread of radioactive material, permit direct radiation shielding to be localized and highly effective, and make possible subsequent plant clean-up with minimum risk of accidental release or exposure to personnel.

5. If leakage from a pressure suppression system should occur, the lower resistance path would cause most of it to flow into the closed refueling building rather than through the ground to the atmosphere. This equipment is vented through clean-up equipment and out through a high stack.

6. As a result of the advantages listed above, post-accident radiation levels outside the containment system would be lower than with conventional dry containment.

Status of construction

Construction at the site started on November 11, 1960, and is expected to be completed in the summer of 1962. Fuel loading, criticality, and initial tests will follow with the aim of starting commercial operation in the fall of 1962.

The Humboldt Bay Power Plant, Nuclear Unit, is being financed entirely by the Pacific Gas and Electric Company. Bechtel Corporation is building the unit under a fixed-price contract with P.G. & E., and is purchasing the reactor and related facilities from the General Electric Company. Total cost of construction is estimated at $20,600,000. General Electric is fabricating the nuclear fuel under a separate contract with P.G. & E.

The analysis and testing of the pressure-suppression concept was conducted jointly by the Pacific Gas and Electric Co. and the General Electric Co.

WHO PAYS for the unexpected

in subsurface construction?

ROBERT F. BORG, F. ASCE

Member, New York State Bar;
Secretary-General Manager,
Kreisler-Borg Construction Company,
White Plains, N. Y.

Editor's Note: The Committee on Contract Administration of the Construction Division of ASCE "enthusiastically endorses" publication of Mr. Borg's article, as developed from committee work.

The problem of who shall bear the risk of unexpected subsurface conditions in construction is one that has plagued the engineering profession for many years. Stated simply the question is: If a contractor is engaged in construction for an Owner in accordance with a previously prepared design, and the Contractor encounters subsurface conditions materially different from what might normally be expected, resulting in increased costs, should the Contractor absorb the increased cost or should the Owner pay it?

ASCE-AGC form of contract, 1960 edition

The Committee on Contract Administration of the ASCE Construction Division (of which the writer is a member) recently encountered this problem again in reviewing the recently revised ASCE-AGC "Suggested Form of Contract for Use in Connection with Engineering and Construction" (1960 edition) (A.G.C. Standard Form 3, ASCE Form JCC-1). During this study, the General Conditions, Section 7, "Familiarity with Work," and Section 8, "Changed Conditions" were reviewed. They read as follows:

SECTION 7. The Owner shall make known to all prospective bidders, prior to the receipt of bids, all information that he may have on subsoil conditions in the vicinity of the work, topographical maps, or other information that might assist the bidder in properly evaluating the amount and character of the work that might be required. Such information is given, however, as being the best factual information available without the assumption of responsibility for its accuracy or for any conclusions that the Contractor might draw therefrom. The Contractor, by careful examination, shall satisfy himself as to the nature and location of the work, such logs of test borings and/or records made of other methods of underground exploration as may be available, the character of equipment and facilities needed preliminary to and during the prosecution of the work, the general and local conditions, and all other matters which can in any way affect the work under this Contract.

SECTION 8. The Contractor shall promptly, and before such conditions are disturbed, notify the Owner in writing of: (1) Subsurface or latent physical conditions at the site differing materially from those indicated in this Contract; or (2) unknown physical conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in this Contract. The Contracting Officer shall promptly investigate the conditions, and if he finds that such conditions do so materially differ and cause an increase or decrease in the cost of, or the time required for, performance of this contract, an equitable adjustment shall be made and the contract modified in writing accordingly. Any claim of the Contractor for adjustment hereunder shall not be allowed unless he has given notice required; provided that the Contracting Officer may, if he determines the facts so justify, consider and adjust any such claim asserted before the date of final settlement of the contract. If the parties fail to agree upon the adjustment to be made, the dispute shall be determined as provided in Section 37 hereof.

There was a lack of unanimity among the Committee members as to what rule could be established to cover the burden of payment for the additional costs. Some members of the Committee felt that the Contractor should absorb the burden, since he had assumed certain risks in engaging in construction and was being paid for a completed job, regardless of the risks involved. Other members of the Committee defended the Contractor against having to assume such a burden. These members felt that construction was difficult enough at best, and that the Owner was usually better able to pay for unusual contingencies. To some extent at least, the Owner pays for the unknown anyway when the Contractor adds a "contingencies" item to his bid.

The issue was not entirely resolved by the Committee. Its chairman, Blair Birdsall, in a letter addressed to the Committee on February 15, 1961, stated:

"I am sure you will agree with me that there is at least one point hanging fire in connection with our discussion of General Conditions; namely, the clause which deals with foundation exploration. Any time any member gets a better idea on this subject I would appreciate it if you would put it on record in the Committee files."

The writer believes that the subject is of sufficient importance to the profession and to the construction industry to justify a statement of it and some of its ramifications to the ASCE membership. It is here presented in the hope that the mature consideration it will receive from increased numbers will result in the shedding of further light on the subject. The writer's views are entirely his own and not necessarily those of the Committee.

Various views

The writer has been keenly interested in the problem for many years. Indeed, a previous paper, "Impossibility of Performance in Contracts

for Engineering and Construction" (*Transactions ASCE*, vol. 116, 1951, p. 1352), was concerned almost entirely with problems of this type.

Tradition and the law have in the past sided with the Owner and against the Contractor in situations of this type, with certain exceptions. As early as the year 1796, an English lawsuit (Bricknock vs. Pritchard) (p. 1353 supra), made one of the earliest known applications of the rule governing this situation as it applied to a construction contract. In the writer's paper mentioned above, many cases are cited in which a Contractor was held to strict performance of the terms of his agreement, and liable for unexpected subsurface contingencies.

The ASCE has itself reaffirmed this rule in its Manual No. 8, "Engineering and Contracting Procedure for Foundations" (1934). Under the heading, "Contractor's Responsibility," p. 4, it is stated that variations in soil encountered during work should not relieve the Contractor of his responsibility or entitle him to extra compensation. On page 12 it is stated that "Soil conditions between borings may be assumed by the Contractor at his own risk."

Who in fact pays?

The Society has already published an excellent paper dealing with the entire subject, "The Risk of the Unexpected in Subsurface Construction Contracts," by Oren Clive Herwitz (*Transactions ASCE*, vol. 105, 1940, p. 454). One might therefore ask, "What more is there to say? It's the Contractor who pays."

Notwithstanding all this, the writer submits that, on the contrary, it is the Owner who in fact pays.

Responsibility has in the past been the lot of the Contractor in the absence of any language to the contrary in the agreement. As a practical matter, few important construction contracts today fail to include some mention or clause regarding unexpected subsurface conditions. The ASCE-AGC form previously cited is an example.

Now if the contract contains such a clause, it will in effect say one of two things:

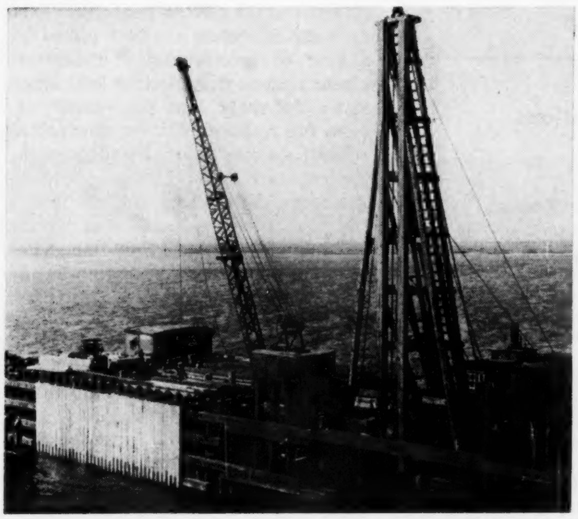
1. The Owner accepts full responsibility for unexpected subsurface conditions and will compensate the Contractor for the extra cost thereof, or
2. The Contractor accepts full responsibility for unexpected subsurface conditions and shall be entitled to no additional compensation whatsoever for the extra cost thereof.

A third type of contract tries to "straddle the fence" and treats the subject ambiguously or in contradictory language in different parts of the agreement.

Where the Owner accepts responsibility for unusual conditions, the Contractor can intelligently prepare his bid and estimate his cost in accordance with the established procedures of construction estimating. The competing Contractors, if more than one has been asked to submit a proposal, all base their estimates on the same assumptions, elevations, quantities and dimensions.

Since only Providence can know the actual conditions that will be met with when the ground is opened, the designing engineer has wisely said in effect, "We think we know as much as it is practical to learn from the data on hand in order to prepare a design using certain agreed-on assumptions as the basis for bidding. If the assumptions prove in need of revision, then we will adjust the final dimensions, quantities and amounts. We admit we are not infallible, nor can we foretell the future, but for the basis of original design and competitive bidding, the use of agreed-on assumptions is the most intelligent way to determine the low bid and to make it possible to start the job." Contingencies, unexpected events, unknown happenings—these are provided for by this engineer as separate budget items kept by his client on the advice and counsel of the engineer. Thus the Owner pays for the unexpected.

On the other hand, let us assume that the second alternative is adopted and the responsibility is placed on the Contractor. In this case there are two possibilities. The bidding may be based on intelligently prepared plans, complete in every detail, with many borings and other data included for the Contractor's study. On the other hand, the plans may be vague, incomplete, and without supporting data for the basis of design. The borings, if given,



A typical pile-driving job involved the jetting of wood piles into place in sand. The underwater work entailed many risks including the under-water welding of steel in swift currents. The work was done for the Triborough Bridge & Tunnel Authority of New York under a unit price contract.

For this project, borings indicated "rock" 8 ft below the surface. When it was discovered that this "rock" was only a boulder and that ledge rock was actually 37 ft below the surface, much work and expense were involved. Such difficulties pose the problem of who is to pay for the extra work.

may be too far removed from critical areas or of dubious quality. In some cases, there may be an admonition against their use, and a disclaimer of any responsibility.

Also the Contractors may be invited to visit the site, to take additional borings, dig test pits, or employ divers (if underwater work is involved). Other suggestions of an impracticable nature may be made which would multiply the cost of estimating far beyond sound business policy, or beyond the time permitted. The bottom elevations of important parts of the work may be omitted and the contract may be completely rigid, stating in effect, "It's entirely your responsibility. All Contractors are gamblers and the contracting business is composed of those willing to take risks."

Here again we assume that competitive bids are being taken from responsible contractors. In actuality, a Contractor is often asked to face such a problem. The quantities of materials, labor and equipment that will be needed are then arrived at as accurately as possible. Portions of the work that are vague are assumed as prudently as practicable.

What cost should the Contractor set on the unknowns? Obviously something must be allowed. The various factors are weighed, including the probabilities, and chances of success in a possible lawsuit. Also the Contractor makes a guess as to the toughness or reasonableness of the design engineer or the Owner and another guess as to the assumptions that will be made by his competitors for the job. Not the least consideration is the amount of profit that is warranted considering the risks involved. Finally a sum in dollars is arrived at as representing all the guessed-at factors, and this "risk fund" is added to the bid.

It is possible that none of the unexpected events the Contractor feared will occur. The Owner will then have paid for something he did not receive and will have spent more for the job than otherwise would have been necessary. Obviously this is undesirable and wasteful.

With either type of agreement, it is the Owner who pays.

Misunderstandings

Now what of the contract or specification that attempts to "straddle the fence," by being unclear and ambiguous. Here one Contractor will interpret in his own favor and bid low without provision for the unexpected; another Contractor will assume that he will be expected to pay and will bid higher because he has included a "risk fund." In all probability the low bidder will be the one who expects to be reimbursed for unexpected subsurface costs. If the Owner is not aware of this, or if he hopes to pin his case on a contradictory clause elsewhere in the agreement, he invites a dispute, and perhaps a lawsuit.

Since in the last analysis, the additional cost of unexpected subsurface conditions is passed on to the Owner, it is preferable to give the Owner the complete and unequivocable responsibility in the specifications and contract. When this is done, the Owner can spend the additional sums in accordance with his own ideas as to when and in what amounts. Also the cost of construction in general is reduced because bidders are not required to provide funds for contingencies that may or may not occur. Bidders become more responsible, fewer disputes arise, and much litigation is avoided.

In the Standard General Conditions of the American Institute of Architects, 1958 edition (A.I.A. Form A-201), the problem is covered by Article 15, "Changes in the Work," the last paragraph of which states:

"Should conditions encountered below the ground be at variance with the conditions indicated by the drawings and specifications the contract sum shall be equitably adjusted upon claim by either party made within a reasonable time after the first observance of the conditions."

In *The Handbook of Architectural Practice* (published by the American Institute of Architects, 1958 edition, Washington, D.C.), this comment on the above paragraph is given on page III 6.08:

"Unexpected subsurface conditions have often created serious hardship, through inadequate information on the drawings, or blanket provisions placing responsibility on the Contractor for unknown conditions, or a combination of the two. Contract drawings on which competitive bids are invited should be definite, and an adjustment of the contract made if conditions are found that are at variance with those indicated by the drawings and specifications."

The writer suggests the form at lower left for use in specifications or contracts for this situation.

It is the writer's opinion that the interests of the Design Engineer, Owner, and Contractor are best served by a type of specification and contract clause such as that given at left, which states definitely that the Owner accepts full responsibility for unexpected subsurface conditions. Its adoption by the engineering, architectural and legal professions would help to reduce the cost of construction, encourage more intelligent and more responsible bidding, and decrease litigation.

The author is indebted to his fellow members of the Committee on Contract Administration of the ASCE Construction Division for their stimulating ideas on this subject. He wishes especially to thank its chairman, Blair Birdsall, F. ASCE, for suggesting the problem and for permission to use certain material from the Committee's files.

The writer will be pleased to receive comments on how the problem of unexpected subsurface conditions can best be handled. His address is 4 Cromwell Place, White Plains, N. Y.

Payment for unexpected subsurface conditions

(Recommended contract clause)

The contract documents indicating the design of the portions of the work below the surface are based upon available data and the judgment of the Engineer. The quantities, dimensions and classes of work shown in the contract documents are agreed upon by the parties as embodying the assumptions from which the contract price was determined.

As the various portions of the subsurface are penetrated during the work, the Contractor shall promptly, and before such conditions are disturbed, notify the Engineer and Owner, in writing, if the actual conditions differ substantially from those which were assumed. The Engineer shall promptly submit to Owner and Contractor a plan or description of the modifications which he proposes should be made in the contract documents. The resulting increase or decrease in the contract price, or the time allowed for the completion of the contract, shall be estimated by the Contractor and submitted to the Engineer in the form of a proposal. If approved by the Engineer, he shall certify the proposal and forward it to the Owner with recommendation for approval. If no agreement can be reached between the Contractor and the Engineer, the question shall be submitted to arbitration as provided elsewhere herein. Upon the Owner's approval of the Engineer's recommendation, or receipt of the ruling of the arbitration board, the contract price and time of completion shall be adjusted by the issuance of a change order in accordance with the provisions of the sections entitled, "Changes in the Work" and "Extensions of Time."

Fabricated rigid frames show savings in mill building

The Steel Company of Canada has just completed a new building at its mill in Hamilton, Ontario, to house continuous galvanizing and aluminizing lines. This structure, which is 1,200 ft long, incorporates rigid-frame design with heavy crane loadings up to 50 tons. The use of Z-section cold-formed purlins and tapered sections for the rigid frame is a departure from traditional mill building design with trusses and heavy rolled sections.

The owners chose this design for two main reasons. First, the use of rigid frames fabricated from plate and the use of cold-formed, high-tensile-steel purlins and girts saved considerable weight. Second, this design permitted the use of about 2,400 tons of plate, which the company manufactures.

The total area is 222,500 sq ft and the weight saving involved in the design averaged 5¼ lb per sq ft, compared with a conventional flat-truss design. The breakdown for a typical 25-ft bay in one of the aisles—of 103-ft span—is given in Table I.

In addition to the initial saving in capital cost, several other advantages were realized from this type of construction:

1. The strength built into the frame for one type of loading gives it strength to sustain other loadings, provided they do not occur simultaneously, because of the continuity of the structure. Thus, large monorails used for maintenance purposes, and not anticipated in the original calculations, did not require heavier material in the frames.

2. The building is easy to expand both laterally and longitudinally.

3. Unlike a truss, there is no horizontal bottom chord, and lateral expansion and contraction in a multiple-span building due to temperature changes can be taken by diaphragm action on the roof, the ridge moving up and down to prevent possible overstressing and buckling of the flanges in the outside columns.

4. A neater and more functional building with a lower eave height and more attractive appearance was possible with rigid frames.

Since large rolled steel shapes are not produced in Canada, the incentive is greater there to use welded, built-up sections. Freight costs of course became important also, and weight saving is a larger factor than it might be in the United States.

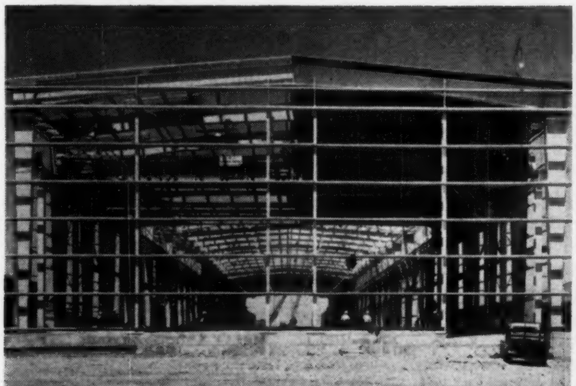
TABLE 1. Weight saving for a typical 25-ft bay of 103-ft span

Building Component Total Weight	Rolled Sections	Fabricated Sections
Rigid frame without haunched knee	53,500 lb	......
Flat truss with columns	41,500 lb	......
Rigid frame with tapered members	......	34,400 lb
Purlin	19 lb per ft	13.6 lb per ft Z-shaped high-tensile
Girt	8.2 lb per ft	4.8 lb per ft Z-shaped high-tensile

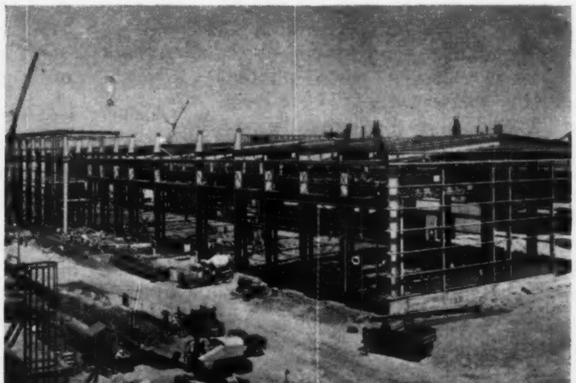
The Butler design involved strict quality control of welding. This control was required for the critical tension welds; it was also made necessary by the use of a single fillet weld on one side of the web-to-flange connection of the rigid-frame members. Samples of these welds were submitted to the Ontario Research Foundation in Toronto for fatigue testing, and were found to be satisfactory.

The purlins and girts were designed in accordance with the AISI Light Gage Cold Formed Steel Design Specification as these involved 14-gage and $\frac{3}{16}$-in. material. The crane runways and the remaining parts of the building were designed according to conventional design procedures using AISC Specifications.

Although engineering costs are higher for this type of structure than for a conventional design, the savings in material more than offset them. The design was supervised by P. C. DiNovo, Chief Engineer, Butler Manufacturing Company (Canada) Limited, fabricators for the job, and B. M. Corey, Supervisor of Civil Engineering, Steel Company of Canada.



Rigid frame of mill building built for Steel Company of Canada yielded a saving of 5¼ lb of steel per sq ft as compared with a conventional flat-truss design.



Because of the continuity of the design, enough strength is built into the frame to sustain additional loadings. The building can be easily expanded in both directions.

THE ELECTRONIC COMPUTER

—it creates *problems* as well as *solutions*

DONALD R. GOODKIND, M. ASCE, Goodkind & O'Dea, Consulting Engineers, Bloomfield, N. J.

Probably no professional group has responded to the potentialities of the electronic computer with more enthusiasm than civil engineers. The reasons for this are obvious but there is another side to the picture. The computer solves some problems but it creates others.

An outstanding problem

Outstanding among the problems it creates is that of training for the recent graduate in an engineering office. Such beginners formerly were indoctrinated into the practice of engineering by being set to check the computations of an experienced senior. While retracing the reasoning as well as the figures which produced the answer, the beginner learned to understand the logical approaches to the problem.

Later, by initiating computations on his own, the young engineer learned what factors influenced the answer. Thus if the moments in the leg of a rigid frame were too large, he found by trial and error that an adjustment of the proportions of the members could reduce the moment and so provide a more efficient frame.

Consider now the case of a young graduate who enters an office served by an electronic computer. He may be faced with only the routine tasks of entering control figures on an input sheet and accepting printed answers from the computer. He will be unaware of the thinking that went into the programming and unable to appreciate the mathematical manipulation the computer has performed to produce the answer. He will be unable to judge whether the answer is reasonable or how the problem might be adjusted to yield a different answer.

Why the computer is valued

The enthusiasm of engineers, particularly those engaged in the design of highways and bridges, for computers is understandable. They are engaged in a practice that requires both judgment and exacting computations. Their mathematical problems often do not extend into the more subtle fields of advanced mathematics, but primarily involve such basic tools as geometry and trigonometry and call for repetitious and time-consuming calculations.

The highway engineer for instance, in developing the high standards of the modern throughway, has been forced to engage in a host of monotonous calculations. The electronic computer is ideally suited to lift this onerous burden from his shoulders and leave him free to give his full attention to the purely professional problems of overall highway alignment, interchange layout, and the structural sections. With such a millennium in view, the highway engineer does not have to be prodded very hard to seek out the potentialities of the computer.

This new tool has also added glamor to the profession, which has long suffered from a certain inferiority complex as it observed such enticing areas as rocketry, electronics and space exploration being opened to engineers in mechanical, electrical and other fields.

To help in this march to a better day, civil engineers have devoted considerable effort to the organization of committees to enlarge the applications of the computer. A noteworthy effort has been expended in planning conferences, publishing bulletins, and publicizing advanced computer applications.

Training the young engineer

Yet all this activity serves to underscore a shortcoming in the civil engineer's approach to his profession. Apparently he has overlooked the basic professional problems which the advent of the computer has produced and which cannot, unfortunately, be programmed for easy solution.

In addition to the problem of training young engineers, the computer creates other professional problems. For example, the expense of a computer operation may make it extremely difficult, if not impossible, for small engineering organizations to function economically in a computer-oriented profession. This expense may also create another serious barrier for the civil engineer who desires to establish an independent practice similar to that of doctors and lawyers.

Consider also the unpleasant situation inherent in a professional field where the key man, the programmer, may be without professional training. In this new world, is the civil engineer about to become subservient to the technician?

Benefits will of course accrue to the engineer of some experience whose previous training and background have created a basis for the exercise of mature judgment. The new graduate faces an entirely different problem. How is he to develop the insight and judgment that will enable him to utilize the services of the computer?

Tentative answers may come from several directions. Perhaps the undergraduate curriculum should be adjusted to place more emphasis on the solution of specific problems. Possibly office routines should be arranged to provide a certain amount of old-fashioned work on the slide rule. Either answer may be prohibitively expensive and time consuming. Yet the profession can afford to ignore this problem only at the risk of bringing on its own demise.

Here the professional societies have a real responsibility which they alone can handle properly. Manufacturers and practicing engineers will continue to promote the computer without the assistance of professional organizations. The attraction of lower costs and greater time saving is incentive enough to assure the continued development of computer mechanisms and techniques.

Other basic problems

A recognition of the value of the computer may at last still the cry that there is a shortage of engineers. For now, relieved of monotonous routines and free finally to practice as profes-

sionals, the present number of engineers, with normal annual replenishment, may be able to satisfy all the foreseeable demands for engineering talent. Perhaps the engineer, in league with the computer, can at last attain a level that will lead to higher salaries and greater prestige.

Perhaps the time has come to make enrollment in engineering schools more selective, to encourage the production of graduates better qualified to cope with the developments the computer promises. This may be better than to stress expansion of enrollment, a policy that may contribute to discouragement and disillusion among a less carefully selected group, many of whom simply will not be able to meet the exacting requirements of this fast-moving, highly technological world.

It is time for engineers to progress beyond the superficial fascination which the computer exerts and to consider its effects on careers and futures in the profession. An effort comparable to that which has been expended in introducing and advancing the use of the computer would go far toward bringing about an understanding of the human problems that are already upon us as a result of its use. The profession has at hand both an urgent problem and a splendid opportunity to achieve greater satisfaction and enhanced status.

EARTHWORK QUANTITIES BY COMPUTER

What factors determine their accuracy?

J. C. BARRETT, Assistant Photronics Engineer, Mississippi State Highway Department, Jackson, Miss.

When we in the Mississippi State Highway Department started calculating final earthwork quantities on a computer (an IBM 650), we developed a program that would allow the project engineers to prepare their data using almost the same method they were accustomed to. One of the requirements we set for ourselves was that the program had to handle separately the yardage on each side of the center line. In addition the program had to be able to accept grade points that applied to only one side of the center line.

For example, if the ditch on the left of the center line at Sta. 10 + 00 in Fig. 1 is not present on the next cross section at Station 11 + 00, it is our policy to assign a grade point between the sections for the left ditch only, in this case, at Sta. 10 + 45.

The inclusion of this capability in our final program has caused more delays and reruns than any other feature. It is also the thing that causes our project engineers the most trouble in preparing their data for submission to the computer center.

The purpose of Phase 1 of the study here described was to determine the relative importance of these grade points and how much they actually contribute to the accuracy of the final quantities.

We were also interested in the effects of plus station cross-sections on the accuracy of the computations. There has always been a division of opinion on the question of just how frequently cross sections should normally be taken. Some say at every station, at curve points, and at breaks in the ground. Others say every 50 ft regardless of terrain. Very few field engineers will agree on a general rule for such spacing. The purpose of Phase 2 of the study was to determine the effects of plus stations on the accuracy of earthwork computations.

Procedure for study

The procedure in Phase 1 consisted of sorting out all the grade-point cards and rerunning the yardage through the computer. The output from the original run, which contained all the grade points, was collated with the output from this new run and the merged deck was used as input for the earthwork analysis program.

The procedure in Phase 2 was the same except that all the plus stations were also sorted out before rerunning to get the quantity.

In the analysis of each of these runs, the original run, with all the grade points and plus stations left in, was assumed to be correct.

For our purposes it was felt that we should know not only the variation in yardage in the project as a whole, but also the maximum variation that would occur anywhere in its length. In other words the variation at the end of the project might be small, but if there was much fluctuation in the yardage within the project, the haul could be heavily affected. Since the effect of deleting any grade point is to increase the yardage, in the Phase 1 computations, where only the grade points were deleted, the maximum deviation occurred at the end of the project. The computer punched out the accumulated cut-and-fill yardage, the yardage difference, and the percentage of difference every five stations. The results of Phase 1 are given in Table I.

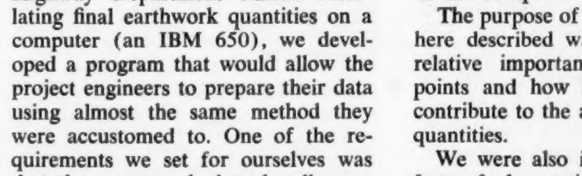


FIG. 1. Cut shown on left side at Sta. 10 + 00 does not appear at Sta. 11 + 00. Therefore a grade point is assigned between the sections for the left ditch only, in this case Sta. 10 + 45.

Conclusion for Phase 1

Because of the small size of the samples, the results obtained on these 12 projects do not justify indisputable conclusions. However the results are uniform enough to indicate a tentative conclusion that the result of deleting all grade points, except where omitted sections occur, will be to increase the yardage total less than 1.5 percent, the average being 0.5 percent. The projects selected for Phase 1 of this study were ones that had a number of grade points for which no cross-sections were taken.

It is admitted that the most accurate cross-sections will result when all grade points are represented by cross-sections. At the same time, it is recognized that this is in most cases an impossibility—that true grade points cannot be determined with complete accuracy in the field. The best solution is to take cross-sections as closely as possible to the grade point in an effort to minimize the error. The results here indicate that if this is done, the error will still be positive, but virtually non-existent.

Conclusion for Phase 2

The results of Phase 2 of the study are given in Table II.

Errors in yardage resulting from the deletion of all plus stations are plus and minus and tend to be compensating. Of the 16 projects included in Phase 2, none had a percentage error at the end of the project of more than 2.2 percent, and the average was 0.8 percent. This small percentage of error however represents a substantial sum when converted to cubic yards at current prices. It is of course unthinkable to consider any procedure other than the most accurate where final pay quantities are concerned. However this small percentage error would seem to justify the practice of taking cross-sections for preliminary estimates at full stations only. If the plus and minus maximum deviations fluctuated widely, it would be possible to have an acceptable overall deviation but a totally unacceptable situation with regard to haul quantities and balanced yardage. This however was not found to be the case. The maximum deviation at any one time was 4.1 percent with an average maximum for all jobs of 0.9 percent. Considering that the haul is based on an estimated shrinkage factor to begin with, normally 20 percent, this maximum deviation seems eminently acceptable from the standpoint of balanced yardage.

In addition to compiling the results of the Phase 1 and 2 computations, we made an analysis of the effects of the various terrain types on the magnitude of the deviation that results from deleting plus sections. Each project engineer was asked to give the percentage of each of three terrain types—flat, rolling, and hilly—which existed on each project. We found that flat terrain contributes about 1 percent to the total magnitude of the deviation and that rolling and hilly terrain contribute about equally to the remaining 99 percent. It is not so surprising that rolling and hilly terrain contribute about equally if it is kept in mind that this refers to a percentage deviation and not to an absolute magnitude. That is, in rolling terrain the total yardage is normally smaller than on a project constructed in hilly terrain. Therefore the magnitude of the deviation in rolling country is undeniably less, but the percentage deviation is about the same as in hilly terrain.

We do not have unbounded confidence that the above relationships are accurate for all projects anywhere in the state. There were too many variables that could not be taken into consideration, and our designations of terrain types were subject to errors of interpretation. The results indicate only the general magnitude of these relationships.

Further study needed

Further research along this line is indicated. In this study the original quantities, run with grade points and plus sections included, were assumed to be exact. This was necessary in order to have a measure for comparison but it is not an accurate assumption.

To properly evaluate the percentage deviations obtained, some comparison should be made regarding the percentage error, plus or minus, inherent in the cross-section method of measurement itself. Some information should be obtained on repeatability of cross-sections taken both by the conventional field methods and by stereoplotters so as to evaluate the importance of the deviations found.

It is important in taking measurements of any kind to know what accuracy is obtainable and what effect certain measurement procedures have on this accuracy. In so far as earthwork quantities are concerned, the electronic computer represents a means, now available for the first time, of obtaining this information at a reasonable cost in both time and money.

TABLE I. Computations by computer with grade points deleted, Phase 1

Project Identification	Unclassified Excavation, Cu yd	Total Deviation Cu yd	Total Deviation %
42003	71,829	+899	+1.3
42004	236,188	+1,170	+0.5
42010	1,138,277	+635	+0.1
42011	110,589	+811	+0.7
42012	1,058,273	+6,369	+0.6
42017	611,444	+5,558	+0.9
42019	117,313	+846	+0.7
42026	189,126	+345	+0.2
42029	2,195,973	+2,971	+0.1
42031	459,090	+3.092	+0.7
59015	769,140	+10,736	+1.4
59019	143,437	+1,767	+1.2
Totals	7,100,679	35,199	0.5*

*Computed from totals

NOTE: The columns for "Maximum Deviation", in cubic yards and percentage, have been omitted from this table because in every case they were identical with the "Total Deviation." This is because the effect of deleting any grade point is to increase the yardage. Therefore the maximum deviation always occurs at the end of the project.

TABLE II. Computations using cross sections on full stations only, Phase 2

Project Identification	Unclassified Excavation Cu yd	Total Deviation Cu yd	Total Deviation %	Max Deviation Cu yd	Max Deviation %
42001	132,843	−58	0.0	+1,286	+4.1
42002	656,174	+14,917	+2.3	+16,994	+2.6
42003	71,829	−85	−0.1	+654	+1.8
42004	236,188	−1,139	−0.5	−1,309	−0.6
42006	197,440	−1,058	−0.5	−1,204	−0.7
42010	1,138,277	+2,840	+0.2	+3,544	+1.2
42011	110,589	+661	+0.6	+986	+4.1
42012	1,058,273	−3,235	−0.3	−4,453	−0.7
42017	611,444	−3,166	−0.5	−5,102	−1.0
42019	117,313	+831	+0.7	+1,275	+1.1
42026	189,126	+175	+0.1	−697	−2.2
42029	2,195,973	+7,392	+0.3	+7,477	+0.3
42031	459,090	+9,139	+2.0	+9,244	+2.0
59015	769,140	+15,882	+2.1	+15,882	+2.0
59018	367,044	+1,781	+0.5	−2,564	−1.4
59019	143,437	+1,175	+0.8	+1,408	+1.0
Total	8,454,180	63,534#	0.8*	74,079#	0.9*

*Computed from totals
#Absolute values

Determining vertical stress beneath a footing

R. ALAN BERGGREN, A.M. ASCE
Field Engineer, New York Central Railroad, Chicago, Ill.

One of the most tedious computations that confronts the foundation engineer is the determination of vertical stress beneath a footing or a series of footings. This stress can be calculated by a multiplicity of methods based on several basic theories. In actual practice, however, the use of these methods is limited by the amount and quality of the information available to the designer. Generally a highly accurate and exhaustive analysis of foundation conditions is neither possible nor feasible.

The writer feels that a theory advanced by Westergaard, and used here, provides the best compromise between actual soil conditions and the data generally available to the foundations engineer. (For an explanation of this theory see D. W. Taylor's *Fundamentals of Soil Mechanics*, p. 258.)

A graphical solution

Since Westergaard's equation, when solved mathematically, is quite complicated, the "*m* and *n* chart" and the "pressure-bulb chart" are employed to provide quicker graphical solutions. In this country the *m* and *n* chart is used extensively because of its applicability to a wide variety of problems while the pressure-bulb method is used generally for the solution of special problems.

The pressure-bulb chart, as mentioned previously, is a graphical solution of Westergaard's equation. The lateral and vertical scales represent functions of the side of a square footing. The circular lines emanating from the edge of the footing are isobaric influence lines giving ratios of a bearing pressure at the footing base of 1 lb per sq ft.

The chart shown here as Fig. 1 was developed for a square footing and gives influence values along either axis directly for such a footing. However, it was found that if the horizontal distance between a point not on the axis and the center of the footing is measured directly, this distance can be rotated to the axis of the footing and the chart read directly. It was also found that if a rectangular footing is encountered, this footing can be divided into equivalent square footings, and the pressure beneath each can be read directly from the chart and added to the other or others without introducing significant errors. It is this procedure which, in the writer's opinion, makes the use of the pressure-bulb chart quicker and more desirable than any method in use at the present time. The following examples will illustrate the procedure.

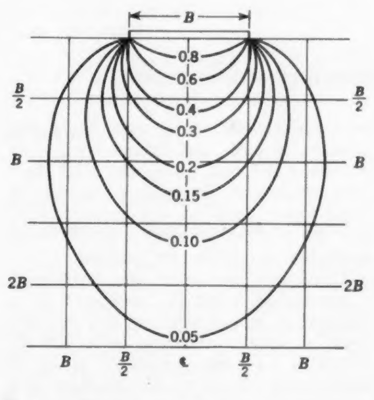


FIG. 1. Pressure-bulb chart gives influence values directly along either axis for a square footing.

Two examples solved

Example 1. To determine the vertical stress.

Given a bearing pressure of 2,000 psf; a footing size of 10 ft x 10 ft, or $B = 10$ ft; a depth at which stress is desired of $H = 5$ ft; a location at which stress is desired where the distance along the axis is $x = 8$ ft and the distance normal to the axis is $y = 5$ ft.

To solve, calculate or scale the horizontal distance from the centerline of the footing to the location where the vertical stress is desired:

$$\sqrt{8^2 + 5^2} = 9.43 \text{ ft}$$

Relate this horizontal distance to the footing width. Thus the distance is $9.43 \div 10 = 0.94\ B$. Relate the depth to the footing width. Therefore the depth is $5 \div 10 = 0.5\ B$. Enter Fig. 1 at a distance of 0.94 *B* and a depth of 0.5 *B* and read the influence value of 0.07. Multiply this influence value by the bearing pressure of the footing to find the vertical stress at the point in question, that is,

$$0.07 \times 2{,}000 = 140 \text{ psf}$$

Example 2. To determine the vertical stress.

Given a bearing pressure of 2,500 psf; a footing size of 6 ft x 8 ft; a depth at which stress is desired of $H = 10$ ft; a location at which stress is desired where the distance along the axis is $x = 3$ ft, and the distance normal to the axis is $y = 4$ ft.

Since the footing in question is not square, it must be divided into equivalent square footings for which the vertical stress can be easily determined. Divide the given footing into an equivalent 6-ft x 6-ft footing and a 2-ft x 8-ft footing, the centers of which are 1 ft nearer and 3 ft farther along the axis from the point in question respectively.

The width, *B*, of the 6-ft x 6-ft footing equals 6 ft. The width, *B*, of the 2-ft x 8-ft footing will equal the width of a square footing having an area of 16 sq ft or 4 ft. Then proceed to determine the influence value and the vertical stress of each equivalent footing as in Example 1 above. The addition of the two vertical stresses found will give the vertical stress desired.

This method provides a simple and quick solution to a tedious computation, within the accuracy required.

THE READERS WRITE

Improving communication between speaker and audience

To the Editor: Communication between many speakers and their audiences at the recent ASCE Convention in Phoenix was far from optimum. This seems to be a common problem of many groups.

Many of the papers were read verbatum from prepared manuscripts; several were read well and effectively. Most of these were read rapidly and with little voice fluctuation. The key points of these papers were usually put across but much of the detail in between was lost. And occasionally the graphs were not intelligible because of either small or light print or simply too much data. On the positive side, discussions stimulated by the papers were highly interesting and worth while and I think should be encouraged even more.

The American Institute of Chemical Engineers has stimulated improvement in the presentation of papers by competition. They give awards to the four best papers at a meeting, based on quality of delivery and content. It is tacitly understood that any paper that is read will not be considered for an award.

ASCE should *do* something to encourage improvement in this important aspect of its meetings.

David W. Hendricks, A.M. ASCE
Instructor, Civil Engineering
University of Idaho

Moscow, Idaho

Editor's Note: *ASCE has two publications which are sent to authors of meeting papers well in advance of the time of presentation. These are the "Authors' Guide to the Publications of the ASCE" and the little pamphlet, "So . . . you're going to present a paper . . ." These pamphlets are available on request to the Executive Secretary of ASCE, 33 West 39th Street, New York 18, N.Y.*

Need for research in our fast-changing world

To the Editor: In his letter to the editor, "Questions Extensive Research in Engineering Schools" (April 1961, pp. 67-68), Robert C. Sheldon deplores the current trend toward research-minded faculties in our civil engineering schools. He questions the necessity of research in engineering schools, and he notes that the "practice" of civil engineering is not taught sufficiently any more.

I would fully agree with Mr. Sheldon if it were our duty to teach engineering as it is practiced today. However, this is not our function. We must prepare engineers who will practice in the future. Since we cannot foretell the future, we must instill in our students the deep desire to question, to search, to improve and to learn throughout their whole lives, for only in this way will they be able to meet the challenge of our fast changing world.

This duty of the engineering teacher can only be adequately fulfilled by men who themselves are involved in research. The search for new knowledge is the only road by which we can save the profession of civil engineering from obsolescence.

Theodore V. Galambos, M. ASCE
Dept. of Civil Engineering
Lehigh University

Bethlehem, Pa.

Fringe benefits in engineering employment

To the Editor: In the May issue (p. 76), Jackson L. Durkee has commented on my article in the February issue (p. 49), "Environment in Exemplary Engineering Offices." Basically, I could not agree with Mr. Durkee more concerning the economics of the cost of fringe benefits. I regret it if any one has been misled, by my use of current personnel terms, to the extent of believing that such costs are not part of the pay or wages of employees.

This matter is further clarified by Oscar S. Bray's most excellent companion paper given at the Boston Convention, on "An Examination of Civil Engineers' Compensation," printed in Civil Engineering for November 1960. For example, Table III of his paper indicates that management's costs for fringe benefits for engineering employment in four of five different fields of civil engineering were astoundingly close to 17 percent of the base payroll, exclusive of Social Security taxes. It must be noted however, that in the fifth category, State Highways, they declined to 13.74 percent.

It is conceded that modern employment practices and personnel policies have become exceedingly complex and in this complexity the basic factor of return to the employee is likely to be obscured. I believe, however, that the employee is able to assess the various elements of compensation in relation to his needs.

Under present-day circumstances very few would prefer to receive the entire package in cash and finance their own vacations and sick leave, and fund their own retirement. I recall a statistic of some years back to the general effect that 90 percent of men over 70 were dependent on others for support.

Moreover, the matter and method of compensation must be considered as a problem in human relations and satisfactions. A solution on these terms has resulted in the establishment of group or cooperative efforts by management and government for or on behalf of employees. Such arrangements may be considered as paternalistic no doubt, but we are subject to dozens of such relationships, fraternal, marital and so forth. In fact, we actively seek such relationships to fulfill our requirements as social beings. True, there is a balance to be maintained if a measure of freedom of individuality and action is to be retained. Nevertheless, both individuals and groups are constrained by the confronting conditions and social attitudes of their time to work out solutions acceptable on an individual or a group basis. Current employment practices merely reflect this.

Irving Francis Ashworth, F. ASCE
Chief Engr. and Chief, Office of Technical Controls, Dept. of City Planning, City of New York

New York, N. Y.

Some aspects of research on thin shells

To the Editor: The tests by Karakas and Scalzi reported in the March 1961 issue, p. 47, are very valuable and research is badly needed in this field. Mention should have been made of the suggested revision of the factor for critical buckling given in ASCE Manual No. 31, "Design of Cylindrical Shell Roofs," p. 98. This factor is 0.2 rather than 0.6, which is one-third of the value given by theory and would make the critical buckling load $2{,}900 \times 0.2/0.6 = 967$ lb, which is precisely the value at which the shell failed.

It should be pointed out that a single barrel without edge members is not a satisfactory structure. The deflections on the prototype would have been very large. The next step is to test shells with configurations similar to those of actual concrete shell structures. Researchers take note.

Milo S. Ketchum, F. ASCE
Ketchum, Konkel and Hastings

Denver, Colo.

Deflection of beams with internal hinges

To the Editor: The article, "Deflection of Beams with Internal Hinges," by Prof. J. L. Sackman, in the March issue, p. 67, brings to mind an article published in *The Journal,* Western Society of Engineers, November 1921, p. 369, entitled "Deflection of Beams by the Conjugate Beam Method," by the late H. M. Westergaard, M. ASCE, then at the University of Illinois. (This is really Mohr's "Method of Elastic Weights," 1868. See Sutherland and Bowman, *Structural Theory,* John Wiley, 4th ed., pp. 391-397.)

The method is this: a conjugate beam is loaded with the *M/EI* diagram of the given beam. For this load the shear and moment curves are computed. These in turn give the slope and deflection curves of the given beam. A simple support at the end of the given beam requires a simple support at the end of the conjugate beam. In the two, internal supports and hinges are interchangeable; also fixed and unsupported ends are interchangeable. Always the lengths of the two are equal.

The conjugate beam solution readily locates the point of maximum deflection; that is, the point where the shear curve for the load of the conjugate beam crosses the axis.

In Professor Sackman's article a drafting or typographical error is probably to blame for the fact that the load must be doubled to get the results given in the example. Furthermore, the deflection curve is in error since the maximum deflection occurs at the left hinge and not under the load.

H. L. Bowman, F. ASCE
Dean of the Faculty
Drexel Inst. of Tech.

Philadelphia, Pa.

Author's reply

To the Editor: The writer wishes to thank Professor Bowman for his comments and for revealing a drafting mistake in the loading diagram; the load should be 2 *P* instead of *P*. (The deflection curve given in the article was not intended to represent an actual scale drawing of the true deflection curve; it was presented only as a schematic sketch.) Professor Bowman is also correct in pointing out that the example given in my article can be solved readily by the conjugate-beam method. As a matter of fact, for that particular example, the extension of the moment-area method to include concentrated areas at the hinges is equivalent to the conjugate-beam method.

But the purpose of the article was to indicate other simple methods for the convenient solution of beams with internal hinges, or internal "hinge-like" mechanisms. The writer feels that the presence of an internal hinge in a beam does not require immediate recourse to the conjugate-beam method; the essential convenience of that method lies outside the fact that it provides a ready means for dealing with beams with internal hinges. By the use of "singularity" functions (some properties of which are given in Crandall and Dahl, *An Introduction to the Mechanics of Solids,* McGraw-Hill, 1959, p. 98), any of the other usual methods (double integration, moment-area) can be extended very simply to handle beams with internal hinges as conveniently as does the conjugate-beam method. This was the intended thesis of the short article.

Other important advantages are associated with the introduction of singularity functions. They are an aid in unifying the treatment of the theory of beam deflections. This generalization of our concept of function covers many situations previously treated as special cases (for example, internal hinges). It is no longer necessary to make the often stated declaration, ". . . the moment-area theorems cannot be applied between two points on the elastic curve if there is a hinge within that portion of the beam." (Norris and Wilbur, *Elementary Structural Analysis,* McGraw-Hill, 2nd Ed., 1960, p. 353.)

If we generalize our idea of function to include singularity functions, then the moment-area theorems certainly do apply across a hinge. The writer feels that the elimination of special cases is a worthwhile elegance and economy. Surely experience in many areas (for example, in the study of numbers) has shown the advantages and conveniences that will accrue through the enlargement of traditional concepts.

Jerome L. Sackman, M. ASCE
Asst. Prof. of Civil Eng.
University of California

Berkeley, Calif.

More on partially developed free-surface flow

To the Editor: In his article, "Energy Equation for Partially Developed Free-Surface Flow" (March issue, p. 66), Professor Kindsvater develops the quantity λ, which describes the reduction in kinetic energy transport due to a partially developed boundary layer. This quantity comes from the general energy equation,

$$\frac{dQ}{dt} = \int_{\text{area}} \left(\frac{U^2}{2} + \frac{p}{\rho} + e + gz\right) \rho\, u dA \quad (1)$$

where Q is the heat energy transferred and e the internal thermal energy. For incompressible, steady flow the quantity,

$$AVgh_L = \frac{dQ}{dt} - \int_{\text{area}} e\rho\, udA \quad . \; . \; . \; . \quad (2)$$

is commonly called the "rate of lost energy" and, thus, h_L the "head lost." The usual procedure is to assume hydrostatic pressure,

$$\frac{p}{\rho} = g\,(y - \eta) \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \quad (3)$$

where y is the liquid depth and η a variable of integration. Then if it is assumed that $u = U$, Eq. 1 for two dimensional flow becomes

$$\frac{U_1^2}{2g} + y_1 + z_1 = \frac{U_2^2}{2g} + y_2 + z_2 + h_L \quad (4)$$

In arriving at Eq. 4, there have been two approximations. The first is that hydrostatic pressure exists and the second is that $u = U$. Professor Kindsvater corrects the second by introduction of the quantity α (which he calls the Coriolis coefficient) but he makes no mention of the first, which can be even more important. The direct integration of Eq. 1 yields an expression of the form,

$$\int \left(g\,\eta + \frac{p}{\rho}\right) ud\eta \quad . \; . \; . \; . \; . \; . \; . \; . \; . \quad (5)$$

It is now necessary to specify $p = p(\eta)$ and $u = u(\eta)$ and integrate the product of pressure and velocity.

It seems that the energy approach is best used to get a quick, approximate answer with the usual assumptions. If one is to specify a velocity profile or boundary layer growth, however, the momentum equation is a more natural approach. The basic momentum equation is

$$F = \int_{\text{area}} A\,\rho\, u^2\, dA \quad . \; . \; . \; . \; . \; . \; . \quad (6)$$

If the factor

$$\beta = \frac{1}{Vq} \int_0^y u^2\, d\eta \quad . \; . \; . \; . \; . \; . \; . \; . \; . \quad (7)$$

is introduced, Eq. 6 can be written as

$$F = \rho\,[\beta_2\, V_2^2\, y_2 - \beta_1\, V_1^2\, y_1]$$
$$= \rho\, q(\beta_2 V_2 - \beta_1 V_1) \quad . \; . \; . \; . \; . \; . \; . \quad (8)$$

Obviously the same factors are involved in the evaluation of β as in the evaluation of α.

The left side of Eq. 8 consists of forces due to hydrostatic pressure, slope, and shear on the bottom of the channel, or, respectively

$$F_x = \int_0^{y_1} pd\eta - \int_0^{y_2} pd\eta + \int_0^L S\rho\, gydx - \int_0^L \tau\, dx \quad . \; . \; . \; . \; . \; . \; . \quad (9)$$

The combination of Eqs. 8 and 9 yields the general expression for one-dimensional, steady, free-surface flow which is suitable for any specified velocity or pressure distribution. The integral of the pressure over the depth still appears, but this time not in a product with the velocity distribution. It must also be remembered that critical flow depth depends upon the pressure distribution if it is other than hydrostatic. Otherwise contradictions occur such as surface waves passing upstream through critical flow sections.

It seems that the momentum formulation will be more fruitful than the energy formulation. Equations 8 and 9 do not combine the pressure and velocity distribution under one integral as do Eqs. 1 and 5. Also the shear term (which can be derived from the boundary layer equations) appears naturally and directly in the momentum formulation whereas it does not in the energy equation.

James A. Liggett, A.M. ASCE
Asst. Prof. of Civil Eng.
University of Wisconsin

Madison, Wis.

Hydraulics Division Conference at University of Illinois

The ASCE Hydraulics Division will hold its Tenth Annual Conference on the University of Illinois campus at Urbana, Ill., Wednesday through Friday, August 16-18. The Central Illinois Section of ASCE and the University of Illinois are co-hosts.

Registration starts at 3 p.m., August 15, at the Men's Residence Hall and is transferred to Gregory Hall on Wednesday. The registration fee is $4 for members; there is no charge for students and ladies.

Supplementing the well-planned technical sessions are unusual opportunities for family fellowship.

Tuesday evening there will be an informal welcome for all at the Men's Residence Hall.

Wednesday offers a coffee hour for the ladies and a swim party for the young people. A Chicken Fry, in an unusual 1,500-acre park, is for all the family for late afternoon and evening. The cost is $1.75 for adults, $1.00 for children.

Thursday features the Conference Banquet at $3.50 per person. During the day there are provisions for golf, tennis and swimming for those not attending the sessions.

Friday has an all-day Lincoln Tour (from 8:00 a.m. to 7:00 p.m.) to Springfield and New Salem State Park for the ladies and young people, at $5 per person, including lunch. The hydraulic laboratories at the University will hold open house Friday afternoon for the engineers.

Saturday, from 8:00 a.m. to noon, there will be a Water Supply and Drainage Tour, to the U.S. Industrial Chemicals Co., in Tuscola, Ill., at $2 per person.

Technical Sessions

All times given are Central Daylight Saving Time

WEDNESDAY MORNING AUG. 16

Ground-Water Hydrology

9:00 a.m. 112 Gregory Hall

Presiding: Maurice L. Dickinson, Chairman, Exec. Committee, and William F. Guyton, Member, Committee on Ground-Water Hydrology

Theoretical and Practical Aspects of Recharge through Wells
Paul Baumann, Consulting Engineer, Sierra Madre, Calif.

Modern Well Design and Construction Procedures
Harman F. Smith, Head, Engineering Sect., Illinois State Water Survey Div., Urbana.

Design and Construction of Water Wells
Owen F. Jensen, Jr., Vice President, Layne Texas Co., Houston, Tex.

Well Logging and Exploration Techniques
Paul H. Jones, Research Geologist, U. S. Geological Survey, Idaho Falls, Idaho.

LUNCHEON

Wednesday, Aug. 16
12:00 to 1:30 p.m.
Men's Residence Hall Dining Room

Presiding: Maurice L. Dickinson, Chairman, Executive Committee

Welcome: Stanley H. Pierce, Associate Dean, College of Engineering, University of Illinois

Greetings: Central Illinois Section, H. O. Scheer, President

Speaker: William H. Wisely, Executive Secretary, American Society of Civil Engineers

Subject: Society Affairs

WEDNESDAY AFTERNOON AUG. 16

Hydraulic Structures

2:15 p.m. 112 Gregory Hall

Presiding: Eugene P. Fortson, Jr., Vice Chairman, Executive Comm., and Harold K. Pratt, Chairman, Committee on Hydraulic Structures

Hydrologic Design of Culverts
Ven Te Chow, Prof. of Hydraulic Eng., Univ. of Illinois, Urbana; and Consulting Editor of *Hydraulic Science and Engineering,* McGraw-Hill Book Co., Inc., New York, N. Y.

Hydraulics at Conventional Highway Culverts
Herbert G. Bossy, Highway Research Engr., Bur. of Public Roads, Washington, D. C.

Improved Inlets for Culverts
John L. French, Hydraulic Engr., Fluid Mechanics Sect., National Bur. of Standards, Washington, D. C.

VISIT AND PICNIC— ROBERT ALLERTON PARK

Wed., Aug. 16, 4:30-9:00 p.m.

Chicken fry in an unusual 1,500-acre park for all the family. See details above.

THURSDAY MORNING AUG. 17

Movie on Break-out of Lake George, Alaska

8:30-9:00 a.m.

(Courtesy U.S.G.S.)

Surface Water Hydrology

9:00 a.m. 112 Gregory Hall

Presiding: Herbert S. Riesbol, Member, Exec. Committee, and Victor A. Koelzer, Member, Committee on Surface Water Hydrology

The Economic Significance of Urban Drainage Design
William J. Bauer, Consulting Engr. and Member, Flood Control Advisory Committee, N. E.

Illinois Metropolitan Area Planning Committee, Chicago, Ill.

A Comparison of Urban and Rural Runoff

JOHN B. STALL and HARMAN F. SMITH, Illinois State Water Survey Div., Urbana.

Analysis of Urban Runoff Hydrographs

CLINT J. KIEFER, Bur. of Eng., Dept. of Public Works, City of Chicago, Ill.

Hydrology of Urban Areas

JOHN C. GEYER, Dept. of Sanitary Eng. and Water Resources, the Johns Hopkins Univ., Baltimore, Md.; and WARREN VIESSMAN, JR., Engineer, William H. Primrose & Assocs., Baltimore, Md.

THURSDAY AFTERNOON

AUG. 17

Sedimentation

1:30 p.m. 112 Gregory Hall

Presiding: Arno T. Lenz, Secretary, Exec. Committee, and Peter S. Eagleson, Member, Committee on Sedimentation

Density and Distribution of Reservoir Sediments

HERMAN G. HEINEMANN, Project Supervisor, Agricultural Research Service, Lincoln, Nebr.

Relation Between Reservoir Sediment Deposition and Selected Watershed Variables

ROGER L. CORINTH, Asst. Engr., Illinois State Water Survey Div., Urbana, Ill.

Sediment Deposition in Small Reservoir Resulting from Urbanization

HAROLD T. GUY, Hydraulic Engr., and GEORGE E. FERGUSON, Div. Hydrologist, U. S. Geological Survey, Water Resources Div., Washington, D. C.

Boundary Shear Stress Distribution in Trapezoidal Channel Curves

ARTHUR T. IPPEN, Prof. of Hydraulics, Dept. of Civil and Sanitary Eng., M. I. T., Cambridge, Mass.; and PHILIP A. DRINKER, Geologist, Agricultural Research Service, Assigned to Hydrodynamics Lab., M. I. T., Cambridge, Mass.

CONFERENCE BANQUET

Thursday, Aug. 17

6:30 p.m. Illini Union Ballroom

Presiding: MAURICE L. DICKINSON, Chairman, Exec. Committee

Speaker: FLOYD E. DOMINY, Commissioner, Bur. of Reclamation, U. S. Dept. of the Interior, Washington, D. C.

Subject: A Challenge to the Hydraulics Engineer

FRIDAY MORNING

AUG. 18

Hydromechanics Session

Cavitation in Hydraulic Structures

9:00 a.m. 112 Gregory Hall

Presiding: Eugene P. Fortson, Jr., Vice Chairman, Exec. Committee, and Frederick R. Brown, Member, Committee on Hydromechanics

Problems Created by Cavitation Phenomena

FREDERICK R. BROWN, Civil Engr., Chief, Hydrodynamics Branch, Waterways Exp. Station, Vicksburg, Miss.

Mechanics of Cavitation

VIRGIL E. JOHNSON, Research Engr., Hydronautics, Inc., Rockville, Md.

Scale Effects Involved in Experimental Work

JAMES M. ROBERTSON, Prof. of Theoretical and Applied Mechanics, College of Eng., Univ. of Illinois, Urbana.

Design Procedures

DONALD COLGATE, Engr., U. S. Bur. of Reclamation, Denver, Colo., and REX A. ELDER, Head, Hydraulic Lab., Tennessee Valley Authority, Knoxville, Tenn.

FRIDAY AFTERNOON

AUG. 18

Hydrometeorology and Flood Control

1:30 p.m. 112 Gregory Hall

Presiding: Herbert S. Reisbol, Member, Exec. Committee, and Wyndham J. Roberts, Member, Committee on Hydrology

Joint Flood Control Operating Center of the State of California, U. S. Corps of Engineers, and U. S. Weather Bureau

CARL A. WERNER, Principal Hydraulic Engr., State Dept. of Water Resources; RONALD H. THOMPSON, Chief of Operations, Sacramento Dist., Corps of Engineers; A. L. ZIMMERMAN, Supervising Meteorologist-Hydrologist, U. S. Weather Bur., Sacramento, Calif.

Studies of Hydrometeorological Factors Influencing Severe Rainstorms on Small Watersheds

GLENN E. STOUT, Head of the Meteorology Sect. and FLOYD A. HUFF, Meteorologist, Illinois State Water Survey Div., Urbana.

Present Status and Future Utilization of Radar, Meteorological Satellites and Quantitative Precipitation Forecasts in the Field of Hydrology

RICHARD D. TARBLE, DAVID W. HOLMES and JERROLD A. LARUE, Meteorologists, U. S. Weather Bur., Washington, D. C. (Mr. Tarble will make the presentation.)

Laboratory Tour

4:00 to 6:00 p.m.

Radar Meteorology Laboratory tour, Illinois State Water Survey Division, University of Illinois airport.

LINCOLN TOUR

All day Friday, to Springfield and New Salem. See details in introduction to program, preceding page.

SATURDAY—WATER SUPPLY AND DRAINAGE TOUR

See details in introduction to program, preceding page.

ACCOMMODATIONS

Rooms in the new Men's Residence Hall will be available at $4.25 per night, single, and $3.00 each, double; children under twelve at half the above rate; no charge for children under two.

Everyone is urged to complete the form on page 124 and return as soon as possible to Prof. James M. Robertson, 125 Talbot Laboratory, University of Illinois, Urbana, Ill., to indicate their tentative plans. Reservations may be made on the form for University dormitory housing.

Many motels and hotels are located within five miles of the University campus. Rates are $5 to $10 single, and $7 to $12 for shared accommodations. Information on hotels and motels will be sent on request.

Local Committee on Arrangements

William C. Ackermann, *Co-chairman*
Ven Te Chow, *Co-chairman*
Wallace M. Lansford, *Co-chairman*
Marlyn E. Clark, *Housing*
John C. Guillou, *Transportation*
Harold W. Humphreys, *Publicity*
Murray B. McPherson, *Technical Program Facilities*
William D. Mitchell, *Finances*
Wyndham J. Roberts, *Ladies and Children*
James M. Robertson, *Registration*
John B. Stall, *Entertainment and Hospitality*

ASCE NEWS

ASCE Outstanding Achievement Award Presented

New York International Airport received the ASCE 1961 Award as the Outstanding Civil Engineering Achievement of the year at ceremonies held at the airport on April 20. The award was presented to Chairman S. Sloan Colt, of the Port of New York Authority, by ASCE President Glenn W. Holcomb. ASCE Vice President Charles B. Molineaux presided.

A jury of civil engineering magazine editors chose New York International Airport for the ASCE award in a nationwide competition. Their selection was affirmed by the Board of Direction of the Society. In announcing its decision, the jury noted that the civil engineering for New York International Airport is "of a magnitude unprecedented in the history of airport planning, design and construction." The judging was based on three categories: (1) engineering skill demonstrated; (2) engineering progress; and (3) value of project to mankind.

In presenting the ASCE award, Professor Holcomb remarked that "probably more than any other engineering project, International Airport best typifies the widespread interests and activities of the civil engineer." He called attention to the many facets of civil engineering that play a part in the development and operation of a great airport—technical and city planning, construction, highway development, hydraulics, irrigation and drainage, sanitation, and structural engineering. Mr. Holcomb noted that International Airport is a sample of the civil engineer's best achievements, and praised it as "without doubt, the greatest airport development of our time."

Chairman Colt, in accepting the award, said that it was gratifying to know that New York International "was selected . . . in direct competition with many other great engineering projects. . . . This would indicate that we have in some degree achieved our objective of making New York International Airport an aerial gateway fitting in all respects for this, the greatest land, sea, and air port in the world."

New York International Airport won the ASCE award in competition with ten other projects nominated—all achievements of civil engineering genius. These were the Niagara Falls Power Development; Portage Lake Bridge, linking Houghton and Hancock, Mich.; the Intelex Post Office Building, Providence, R. I.; Pan American World Airways Terminal at New York International Airport; the Chase Manhattan Bank, New York; the Dresden Nuclear Power Station, Chicago; the Hyperion Effluent Outfall, El Segundo, Calif.; The Geysers Power Plant, Sonoma, Calif.; Lloyd Shopping Center, Portland, Ore.; and Grand Isle Sulphur Mine, Gulf of Mexico.

To date the Port Authority has invested over $290,000,000 in New York International Airport. The budget for construction in 1961 amounts to $40 million. Last year, the airport handled more than 8,830,000 air travelers, 276,110,000 pounds of cargo, and 88,235,000 pounds of air mail.

There are now 300 business organizations and government agencies doing business at New York International Airport, with a total of 28,500 employees earning $191,000,000 a year. By 1965, it is expected that the airport will provide jobs for 32,000 people with an annual payroll of $260,000,000.

On hand for the plaque-presentation ceremonies at New York International Airport were, in usual order, ASCE President Glenn Holcomb, who presented the Civil Engineering Achievement Award in behalf of the Society; John Kyle, chief engineer, Port of New York Authority; Roger Gilman, director of port development for the Authority; ASCE Executive Secretary William H. Wisely; and Alexander Halpern, Commissioner of the Port Authority.

Rockfill Dam Symposium Published by ASCE

Papers presented at the ASCE Portland Convention in June 1958 constitute the latest addition to the growing list of Society publications. The Symposium on Rockfill Dams is now available as Transactions, 1960, Vol. 125, Part II (in cloth binding only), at a list price of $12.00. ASCE members and public and school libraries will pay $6.00. Copies of this 712-page book can be ordered by use of the coupon on page 151.

The papers in the symposium were planned to provide design, construction, and performance data on most of the world's high rockfill dams. The discussions are arranged to introduce material on additional dams and to bring performance data on the dams in the original papers up to date. The detailed presentation of settlement data is said to be of particular value in this field.

Rockfill dams are increasingly used throughout the world and are being constructed to ever-greater heights. The new symposium has been published to provide a comprehensive and convenient reference work in the field.

ASCE Life Insurance Plan Pays First Dividend

Members participating in the ASCE Group Life Insurance Plan will receive their first dividend in June. The first year of the Group Insurance Plan ended on March 1. Attesting to the interest of members in the Plan is the fact that 1,764 applications were received in its first year of operation. The Group Life Insurance Plan is part of the ASCE insurance program for the membership, which has been in existence since 1949.

The dividend declared for the first policy year will take the form of a credit on the June 1st quarterly billing. This dividend credit will be sufficient to pay the full quarterly premium in the case of members who were covered during the entire first policy year. For members who were covered only part of the policy year, the dividend credit will be in proportion to the premium paid.

A change in the manner of handling the administration of costs will bring about a permanent 10 percent reduction in premium contributions. This lower rate also becomes effective June 1.

A recent study revealed the need for additional coverage for members over 45. In the interest of this group, the Board of Direction has approved a plan providing more protection for older members. Details of this additional coverage will be made available in the July mailing. At this time all members now insured will receive a separate mailing offering them the additional coverage. The additional coverage will be in the form of $10,000 of insurance, with premium increasing every five years up to age 60, when the amount of insurance will be reduced annually to age 70.

Chi Epsilon Asks Funds For UEC Conference Room

As announced in CIVIL ENGINEERING, Chi Epsilon Fraternity, national civil engineering honor society, has generously offered to supply funds for furnishing a formal Conference Room in the new United Engineering Center as its gift to the UEC campaign. This room, to be called "The Chi Epsilon Room," will be on the ASCE executive floor and will be available for conferences and for committee meetings.

Pledges are not expected. However, single voluntary gifts, from members of the fraternity, will be very welcome. An attractive Commemoration Book has been planned, in which donors of $100 or more (singly or in groups) may inscribe the name of a venerated friend or acquaintance. Gifts are tax deductible if checks are made out to ASCE Chi Epsilon Room Fund and mailed to Donald D. King, Assistant to the Secretary of ASCE, 33 West 39th Street, New York 18, N.Y. Your gift will automatically be credited to the quota of your initiating chapter.

Full details of the Chi Epsilon contribution are given in a descriptive brochure, which is available from the national chairman, Samuel Kramer, 8701 Shore Road, Brooklyn 9, N.Y The national goal is $10,000.

Dutch Engineer Completes U. S. Lecture Tour

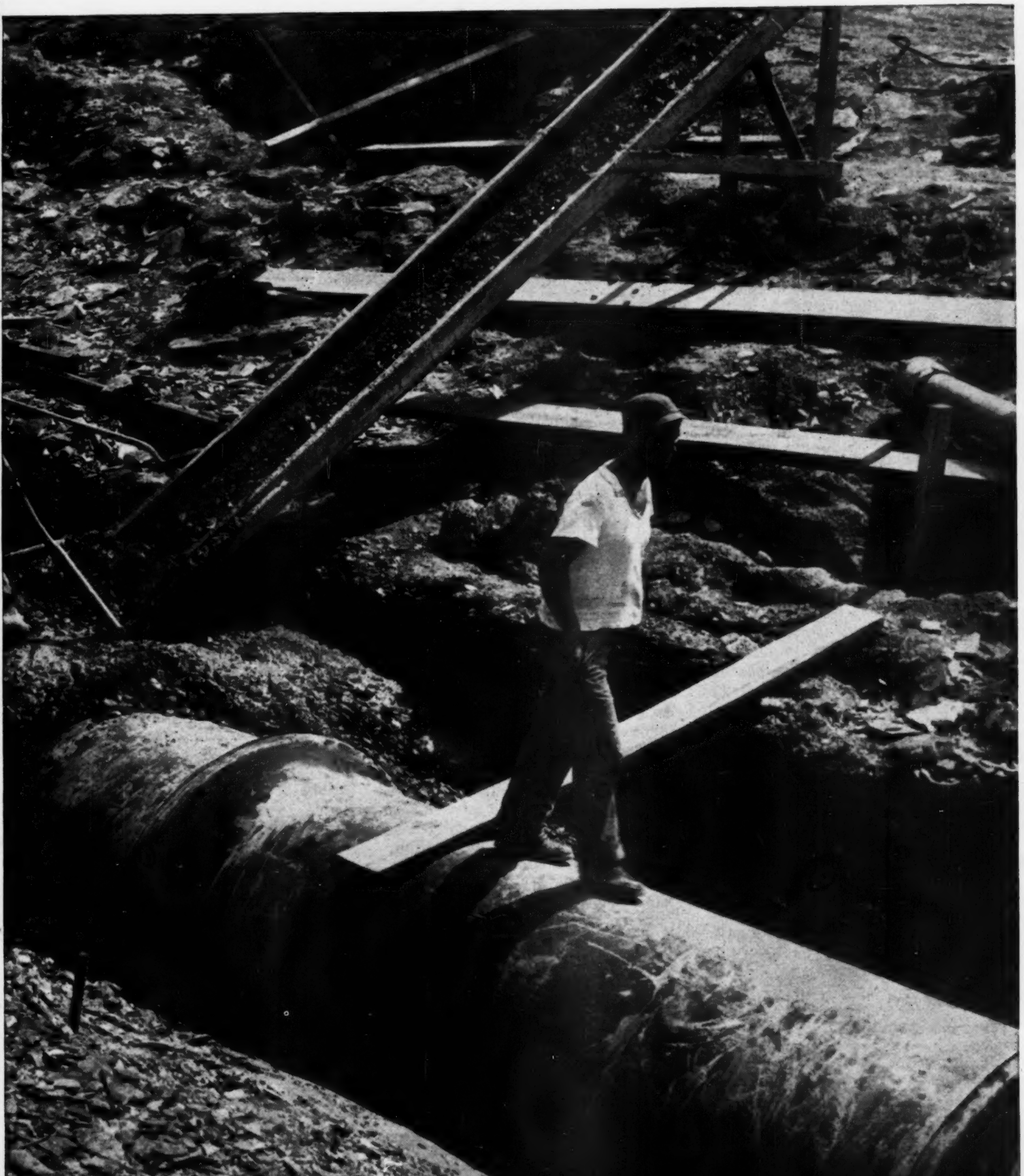
This spring hydraulics engineers and students in many parts of the country have had the opportunity of hearing J. B. Schijf, a distinguished Dutch engineer, lecture on various aspects of Holland's coastal engineering problem. Early in May Mr. Schijf returned to The Hague after a two-month lecture tour, in which he addressed thirty-eight groups, including leading universities and hydraulics laboratories. He also spoke informally before a number of Local Section groups. His lecture was sponsored by the ASCE Hydraulics Division and the Engineers Joint Council, with a financial grant from the National Science Foundation. Prof. Arthur T. Ippen, of M.I.T., was tour coordinator.

Since 1950 Mr. Schijf has been chief engineer of the Rijkswaterstaat, the state reclamation agency, which combines flood control and reclamation functions handled in this country by the Corps of Engineers and the Bureau of Reclamation. Prior to his connection with the Rijkswaterstaat, Mr. Schijf was research engineer and, later, deputy director of the Hydraulics Laboratory at Delft. He is a 1929 graduate of the Delft Technical University. Last summer Mr. Schijf served as secretary of the Seventh Conference on Coastal Engineering, which was held at The Hague under joint sponsorship of the Council on Wave Research of Engineering Foundation and the Rijkswaterstaat.

In his U.S. tour Mr. Schijf offered three lectures: "Wresting New Lands from the Sea"; "Salinity Problems"; and "Closing of the Dikes." He expressed surprise at the high degree of interest in coastal engineering shown by students in Middle Western universities—"about as far from any coast as you can get." In fact, he found most students "more hydraulic-engineering conscious than one would expect." In Holland of course, he added, "it's be interested in hydraulics or perish." Mr. Schijf was also "impressed by the great interest in research manifest in many university laboratories."

Typical of ASCE groups addressed by Mr. Schijf was the Hydraulics Group of the Los Angeles Section. Mr. Schijf is seen here with some of the officers of the Group. Reading, left to right, are Dr. Norman H. Brooks, vice chairman; A. P. Gildea, chairman; Mr. Schijf; and Dr. Vito A. Vanoni, former chairman.

Rugged, every inch of the way
Cast iron pipe was made for tough jobs such as sewage disposal. It resists attack by sewage and sewage gases that require expensive linings in other types of pipe; it keeps sewage flowing smoothly.
Cast iron pipe performs a tough job. It stands up to external and internal loads, shocks and pressures. Bottle-tight joints *eliminate* seepage and infiltration at the most vulnerable points of your system.
Cast iron pipe is rugged every inch of the way . . . and will remain so for over a century.
CAST IRON PIPE
THE MARK OF PIPE THAT LASTS OVER 100 YEARS
CAST IRON PIPE RESEARCH ASSOCIATION
Thos. F. Wolfe, Managing Director, 3440 Prudential Plaza, Chicago 1, Illinois



Finley Laverty Wins ASCE Professional Award

At its Phoenix meeting the Board of Direction selected Finley B. Laverty, assistant chief engineer of the Los Angeles County Flood Control District and a former ASCE Director, as this year's winner of the Society's Professional Recognition Award. Mr. Laverty was cited, "For an established reputation for professional service as a dedicated member of the Society; for his effective work in the advancement of engineering education and the development of future engineers; for significant contributions toward improvement of employment conditions among civil engineers as exemplified by his pioneer effort in establishing engineering job classifications and salary schedules." Presentation of the award, consisting of a wall plaque and certificate, will be made at the Society's Annual Convention in October.

Since 1930 Mr. Laverty has been connected with the Los Angeles County Flood Control District, which he has served as engineer, chief hydraulic engineer, and (since 1958) as assistant chief engineer. In his long tenure with the District, he has directed the operation of 14 major dams, 52 debris basins, and over 2,000 acres of water-conservation grounds. He is widely known for his researches in water conservation, especially in recharging ground-water wells as a barrier to salt-water intrusion. Mr. Laverty is a graduate of Occidental College, with a B.S. degree in C.E. from Massachusetts Institute of Technology.

Long active in the Society, he served as Director from 1956 to 1959. In 1957 he received a Los Angeles Section award as the engineer who

had done the most for the Section and for the civil engineering profession in the Los Angeles County area during the year. He has also been active in the Los Angeles Engineering Council; the Los Angeles Technical Societies Council, of which he was organizing chairman; and the Southern California Industry-Education Council, of which he is currently a director.

The Professional Recognition Award was established in 1959 with funds contributed by Edmund Friedman, former Director and Vice President of the Society. Its purpose is "to recognize the importance of professional attainment in the advancement of the science and profession of engineering" as defined by the Constitution of the Society. E. L. Chandler, who retired last year as Assistant Secretary of the Society, was the first recipient of the award.

Charles M. Barber Is New Director of ASCE

At its Phoenix meeting the Board of Direction selected Charles Merrill Barber, consulting engineer of Cleveland, Ohio, as ASCE Director for District 9, to replace John Scalzi who has moved out of the District and is no longer eligible to represent the area.

As a partner since 1946 in the Cleveland structural engineering firm of Barber, Magee & Hoffman (and its predecessor firm of Barber & Magee), Mr. Barber is responsible for many notable projects in the area, including the Cleveland Museum of Art Addition and the Cleveland Engineering Society Building. He was educated at the University of Toledo and Ohio

State University, graduating from the latter in 1929 with the degree of Bachelor of Architectural Engineering. In 1934, after early experience with the architectural firm of Walker & Weeks, he established his own consulting structural practice, which he maintained until 1942. From the latter year until 1946 he was in military service with the Corps of Engineers, in which he attained the rank of lieutenant colonel.

Mr. Barber has also been a lecturer at Case Institute of Technology and at Western Reserve University. Other special services include consultant to the City of Cleveland on writing a new building code for the city; consultant to the Eastern Defense Air Command at Newburgh, N.Y.; and consultant on the design of three Nato Air Bases in France. For three years he was also a member of the Cleveland Board of Building Standards and Building Appeals.

Long active in the Cleveland Section, Mr. Barber has served it as director and president and has filled many committee assignments. He is currently a member of the Joint Cooperative Committee of Greater Cleveland. Mr. Barber also played an active part in the formation of the District 9 Council.

Back Issues of ASCE Division Journals Needed

In assembling a set of back issues of the Division Journals for the ASCE Publications Record Room at the new United Engineering Center, soon to be dedicated in New York City, staff headquarters finds itself lacking the following issues:

Divisions	1956	1957
Air Transport	May	
City Planning	February, May	
Engineering Mechanics		April
Highway	May	
Hydraulics	April, June, August	
Irrigation and Drainage	February	
Pipeline		March
Power	February, April, June	February
Soil Mechanics and Foundations	January, October	
Structural	March, May	
Surveying and Mapping	March	
Waterways and Harbors	April, May, September	

Members who can spare any of these copies will be doing the Society a service by mailing them to Harold Larsen, Room 1607, 33 West 39th Street, New York 18, N.Y.

ALPHA

BETTER CONSTRUCTION THROUGH BETTER USE OF CEMENTS

news and notes from the field

Modern Curing Methods Improve Concrete Quality

When cement is mixed with water it undergoes a chemical change that transforms it into "rock". When it hardens into a mass similar to rock, it is said to have hydrated. Therefore, hydration is nothing more than a chemical combination of cement and water. First, the outside of the cement particle hydrates and a cement gel (glue) is formed. As water continues to soak through this cement gel, further hydration takes place in the cement particle. The process of keeping the concrete damp and at about 70°F until it is strong enough to do the job for which it is intended is known as curing.

Importance of Curing

Curing consists of keeping the water necessary for forming the cement gel **in** the concrete and keeping the concrete at a temperature high enough or low enough so the chemical change to "rock" can take place.

For example, an average 6-bag mix using 1″ aggregate can be expected to attain a strength of 3950 psi at 28 days if it is cured properly at 70°F. If the temperature is allowed to drop just 20° to 50°F, this same concrete will be slowed down in its transformation to rock and will have a strength of only 2400 psi. The same proportional differences can be expected at all ages. If during the curing period the concrete is allowed to dry out, such as may happen in hot weather, the chemical change stops right at the point where the concrete loses its moisture. Unfortunately, it is impossible to ever make the concrete good even though water is applied later.

Effect on Wearability

Since evaporation occurs more rapidly from the surface of concrete, the length of curing time is the most important factor affecting wearability. A surface that is moist cured for 28 days will result in a floor that is twice as hard as one that is protected only 3 days.

Effect on Watertightness

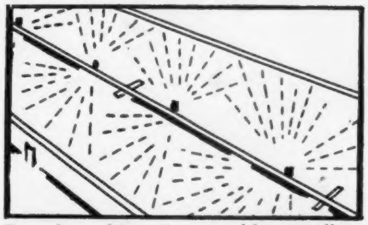
A well-proportioned and workable concrete mix generally contains about twice as much mixing water as is necessary for hydration of the cement. The reason is that about one-half of the water is used to make the concrete workable. As the cement and water hydrates, a gel is formed which expands to fill the voids left by the unneeded water as it evaporates from the concrete. If curing is stopped at one of the intermediate stages, the voids that are normally filled by the gel are left at whatever stage curing is stopped, making the concrete porous and leaky.

Effect on Durability

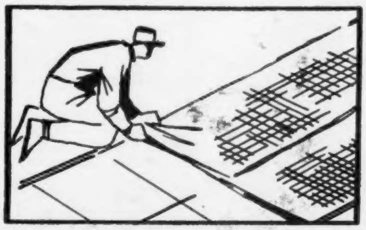
The durability or the ability of concrete to withstand the effects of freezing, thawing and weather conditions is a direct result of how much water the concrete can absorb. If the concrete quality is good to start with and if it has been cured properly, there will be no pores or capillaries through which water can enter and freeze, subsequently expanding and causing scaling.

Air entrainment helps eliminate deterioration caused by freezing and thawing cycles but good construction practices must also be followed—that means good curing.

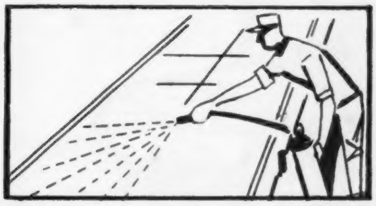
Methods of Curing



Spraying with water provides excellent results if constantly kept wet. There is a possibility of drying between sprinklings and it presents some difficulties on vertical walls.



Burlap which is kept damp during curing period. Recent improvements have made burlap easier to handle, improved light reflectance and increased its fire resistance.



Membrane compounds are inexpensive and easily applied by spraying. They are available clear, black and white. Caution must be taken that the film is not broken or tracked off before curing is completed.

Waterproof paper furnishes excellent protection against drying by providing a moisture barrier that assures proper hydration. Curing papers that are reinforced last longer, and can be reused several times.

Plastic sheets are absolutely water-tight, are light and easy to handle, and provide excellent protection. They resist rotting and mildew and can be reused many times.

Other curing methods include wet earth and sand which are messy and require excessive manpower. Straw and hay are only moderately efficient; they can dry out, blow away or burn.

Test specimens show that poorly cured concrete can easily lose 50 per cent of its potential strength. **And to ignore curing is the same as removing half the cement from a concrete mix.** It is much more economical to spend a few cents per square yard in proper curing, than to spend many dollars using excessive quantities of cement. And without curing, even high cement-factor concrete can be seriously damaged.

Reprints of this page are available on request.

ALPHA

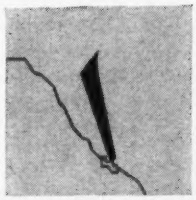
PORTLAND CEMENT COMPANY

Alpha Building, Easton, Pa.

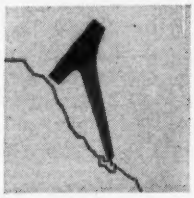
modern 320-ft. spans?

This mark tells you a product
is made of modern, dependable Steel

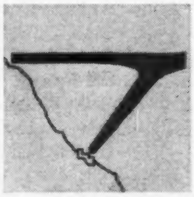
Here's how American Bridge did it:



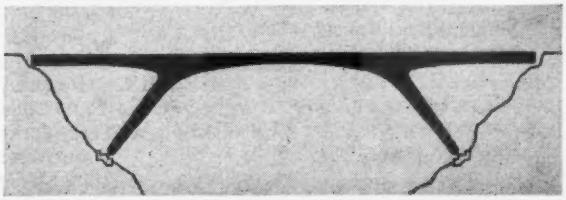
1. First, a column was attached to its abutment and raised into a vertical position.



2. The haunch girder section was then lowered into place and fastened.



3. The whole section was rotated into position and the final girder set into place. The leg and span were then self supporting. This operation was repeated from both sides until all legs and end spans were in place.



4. Center spans were then slid down the embankment and hoisted into place.

It took less than two months to erect all 568 tons of steel.

American Bridge has the experience, facilities, the right men and the imagination it takes to build bridges of any kind. If you're not familiar with our service, contact the nearest American Bridge Contracting office.

USS is a registered trademark

General Offices: 525 William Penn Place, Pittsburgh, Pa. Contracting Offices in: Ambridge • Atlanta • Baltimore • Birmingham • Boston • Chicago • Cincinnati • Cleveland • Dallas • Denver • Detroit • Elmira • Gary • Harrisburg, Pa. • Houston • Los Angeles • Memphis • Minneapolis • New York • Orange, Texas • Philadelphia • Pittsburgh • Portland, Ore. • Roanoke • St. Louis • San Francisco • Trenton • United States Steel Export Company, New York

Society Commends Student Chapter Work

President Holcomb has announced the annual awards to Student Chapters for outstanding work during the 1960-1961 school year. Fifteen Student Chapters have been honored with Certificates of Commendation, and 60 Chapters have been awarded Letters of Honorable Mention.

Chapters receiving Certificates are:

Northeastern Region
The Cooper Union
University of Maine
University of Massachusetts

North Central Region
Kansas State University
University of Nebraska
South Dakota State College

Middle Atlantic Region
Carnegie Institute of Technology
University of Delaware
University of Maryland

Southern Region
University of Alabama
University of Puerto Rico
University of Tennessee

Western Region
University of Arizona
Montana State College
Washington State University

The Letters of Honorable Mention commending Chapters for their excellent work go to the following schools:

Northeastern Region
Clarkson College of Technology
University of Connecticut
Manhattan College
Newark College of Engineering
Norwich University
Rutgers University
Syracuse University
University of Vermont
Worcester Polytechnic Institute
Yale University

Middle Atlantic Region
Bucknell University
University of Cincinnati
Johns Hopkins University
Lehigh University
University of Michigan
Ohio State University
Pennsylvania State University
University of Pittsburgh

North Central Region
Illinois Institute of Technology
University of Illinois
University of Illinois (Navy Pier Branch)
Iowa State University
University of Kansas
University of Louisville
University of Missouri
Missouri School of Mines & Metallurgy
Northwestern University
University of Notre Dame
Valparaiso University
University of Wisconsin

Southern Region
Auburn University
Catholic University of America
The Citadel
Clemson A & M College
Duke University
Georgia Institute of Technology
Howard University
Louisiana Polytechnic Institute
Louisiana State University
North Carolina State College
Rice University
University of South Carolina
University of Southwestern Louisiana
A & M College of Texas
Texas Technological College
Texas Western College
Tulane University
Virginia Military Institute
Virginia Polytechnic Institute
University of Virginia

Western Region
Colorado State University
University of Colorado
University of Denver
University of Idaho
University of Nevada
San Diego State College
University of Southern California
University of Utah
University of Washington
University of Wyoming

ASCE Manual Features Plastic Design in Steel

The evaluation of a considerable amount of research work has demonstrated the applicability of plastic analysis to structural design. For the type of structure to which its application is intended, plastic design results in overall balance and in more economical use of material than conventional methods. In comparison with allowable stress ("elastic") design methods, plastic design is a simpler technique. As a consequence, designers have chosen this design method for more than 2,000 structures built in the United States and many foreign countries.

A "Commentary on Plastic Design in Steel" is the most recent addition to the series of ASCE Manuals of Engineering Practice. The new Manual is the result of the work of a joint committee from the Welding Research Council and the Engineering Mechanics Division of ASCE. Although much of the experimental and theoretical work was performed at Lehigh University, the joint committee has broadened the commentary by including the results of research done in other institutions, both in the United States and abroad.

A coupon for ordering copies of the new reference, identified as ASCE Manual No. 41, appears on page 151. The list price is $7.00, with the usual 50 percent discount to ASCE members and to public and school libraries. This Manual is available in either cloth binding or paper cover; the cost is the same.

Proceedings of Coastal Engineering Conference

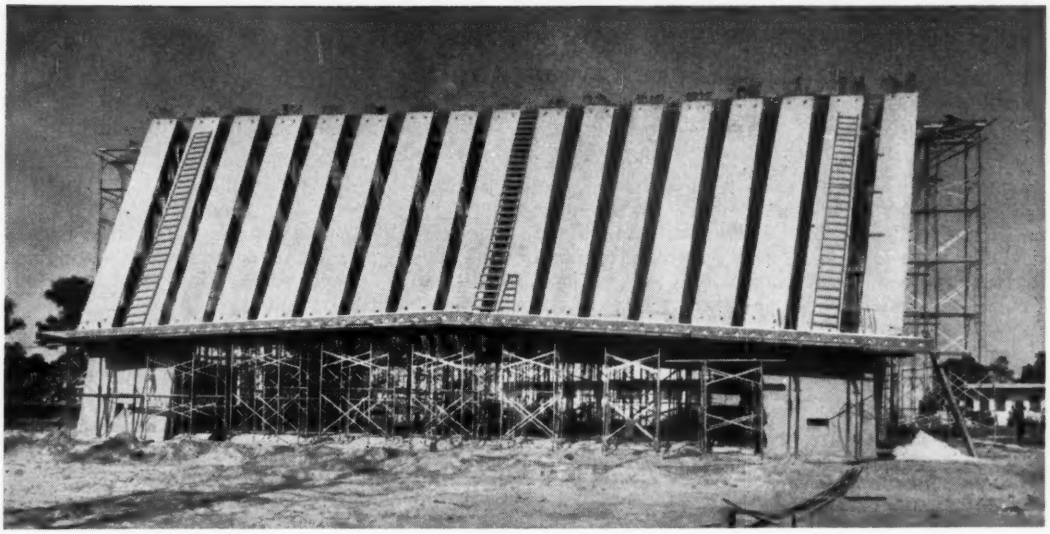
Availability of the Proceedings of the Seventh Conference on Coastal Engineering—held at The Hague, Netherlands, in August 1960—is announced. The important conference, which covered coastal engineering developments all over the world, was sponsored jointly by the Council on Wave Research and the Rijkswaterstaat of the Netherlands. The Council on Wave Research, initiated in 1950 by the ASCE Hydraulics Division with Engineering Foundation support, is now an independent Engineering Foundation project.

The two-volume, 1,000-page Proceedings sells for $12.50. Inquiries should be addressed to J. W. Johnson, Secretary of the Council on Wave Research (and volume editor), University of California Richmond Field Station, Building 159, Richmond 4, Calif.

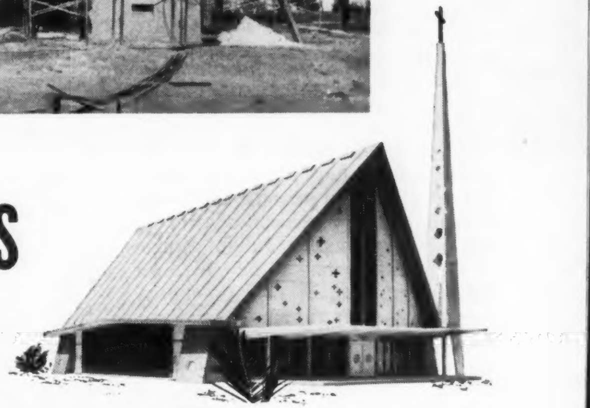
ASCE Membership as of May 11, 1961

Fellows	11,136
Members	16,665
Associate Members	19,266
Affiliate Members	118
Honorary Members	51
Total	47,236
(May 9, 1960	45,198)

Double tee beams are 45′ long, 4′ wide, 15″ deep, and weigh 5 tons. The side beams, which support the double tees, are 95′ long, 9′ wide, 12″ thick, have a 2′ rise at the center, and an exposed aggregate finish.



PRESTRESSED DOUBLE TEES for unique roof structure...



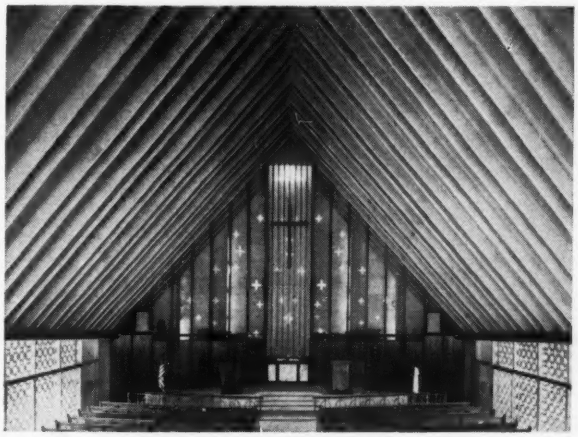
• The design of Melrose Park Community Methodist Church, Ft. Lauderdale, Fla., called for a new and imaginative use of standard prestressed concrete double tees. Capped with concrete at the top and secured at the bottom on two huge cast-in-place beams, the 34 double tees make up the "backbone" of the roof structure. The 24″ open spaces between the double tees were filled with a pneumatically placed mortar. The end result is, in effect, a single, giant folded plate supported only by the corner abutments.

In the manufacture of the double tees, R. H. Wright, Inc. used Lehigh Early Strength Cement. Consistent use of this type of cement in their prestressing operations helps them attain maximum production efficiency through early removal of units and quick re-use of forms.

This is typical of the advantages of Lehigh Early Strength Cement in modern concrete construction. Lehigh Portland Cement Company, Allentown, Pa.

LEHIGH CEMENTS

Non-load-bearing precast columns support 3′ x 8′ terrazzo facade panels. Bell tower is 85′ high, 6′ wide at the base, and was precast in 9 sections with Lehigh Early Strength Cement. Abutment structures are 10′4″ x 5′ with 12″ walls, and have an exposed aggregate finish.



Acoustical plaster was sprayed over exposed double tees. The structure presently seats 510 with future plans calling for the addition of wings to increase seating capacity to over 1,000.

Architect: Robert E. Hansen, A.I.A.
Engineer: Walter Harry Assoc.
Contractor: Casmal Construction Co.
Manufacture and Erection Prestressed/Precast Concrete: R. H. Wright, Inc.
All of Ft. Lauderdale, Florida

CONCRETE PERFORMANCE REPORT:

Controlled performance concrete was needed for TWA Terminal roof shell

The 5500 ton roof of Eero Saarinen's distinctive TWA terminal at Idlewild Airport is an arch cantilever design—with four monolithic concrete shells, joined integrally at the centerplate, flowing out of four sculptured concrete buttresses. Every detail of the terminal building performs an engineering function . . . a perfect wedding of form and structure that carries design loads gracefully down to the ground.

Consideration for concrete mixes —In proportioning the 4000 psi conventional concrete for the buttresses and lightweight concrete for the shells, special consideration was given to these factors: (1) lowest possible unit water content and low cement content to minimize shrinkage (2) careful control of slump which had to be varied for different areas of the shell (3) precise control of setting time to assure a completely monolithic structure for each shell and to allow finishing the surface to the final complex architectural contours. Also, in the buttresses and thick sections of the shell a low rate of heat evolution was required to minimize thermal stresses.

Test models — Three test models were constructed to simulate the placing conditions that would be experienced in different areas of the shell. These duplicated the angle of incline and the contours of the shell and the amount of intricate reinforcing steel in these areas. Work with these models showed that top forms had to be used where the slope of the shell was steep and that 5″ slump was necessary to place the concrete beneath the counterform. In the less steep areas where counterforms were not necessary, the concrete could be placed with 3″ slump without flowing or sagging down the slope.

Mix proportions — Preliminary work showed that these objectives were best met with POZZOLITH concrete. The trap rock concrete for the buttresses contained 606 lbs. of cement, POZZOLITH Retarder, 6% entrained air and had a unit weight of 150 lbs. The Norlite lightweight concrete for the shells contained 614 lbs. of cement, POZZOLITH Retarder, and 23 gallons of water for the 5″ slump mix placed under the top forms. Air content was 6% and unit weight was 115 lbs. By simply regulating the amount of POZZOLITH Retarder for each individual load of concrete, the set was retarded, as required, in the range of one to four hours. The two batching stations got their instructions by field telephone from the concreting superintendent on the roof.

Results — Concrete was placed in a round-the-clock operation averaging 27 hours per shell. Removal of top forms proceeded on schedule. The concrete finished easily, with good texture and no plastic cracking. There

TWA

EERO SAARINEN'S MODEL of new TWA unit terminal, Idlewild Airport, New York. Two-and-one-half year project scheduled for completion in late 1961. 50,000 sq. ft. lightweight concrete roof shell—supported by only four concrete buttresses—weighs 5500 tons, contains 3200 cu. yd. of POZZOLITH concrete and 500 tons of steel.

Architect: Eero Saarinen & Associates • Supervising Resident Architect: Ralph Yeakel • Consulting Engineers: Ammann & Whitney—Boyd G. Anderson, Senior Partner in Charge • General Contractor: Grove, Shepherd, Wilson & Kruge, Inc. — Kenneth P. Morris, Field Project Manager • Testing: Haller Testing Laboratories, Inc.

District 10 Council Meets in Florida

A wide range of Society and Section problems came up for study at a two-day District 10 Council meeting held at St. Petersburg, Fla., April 28 and 29. Seated left to right, are Christopher Tyson, delegate from South Florida Section; Lewis A. Young, delegate from Georgia Section; John B. Benson, Jr., president of West Coast Branch of Florida Section; and Albert E. Johnson, Columbia, S.C., vice chairman of conference. In middle row (usual order) are Don H. Mattern, ASCE Vice President for Zone II; Byron D. Spangler, delegate from Florida Section; James F. Shivler, Jr., Jacksonville, Fla., conference chairman; C. R. McCullough, president of North Carolina Section and Section delegate; James M. Faircloth, delegate from Alabama Section; Robert C. Blair, president of South Carolina Section and Section delegate; and John D. Watson, ASCE Director for District 10. In last row are Daniel B. Barge, Jr., delegate from Nashville Section, and Hozmer B. Wright, president of Florida Section.

ASCE ENGINEERING SALARY INDEX

(Prepared Semiannually)

Consulting Firms

City	Current	Previous
Atlanta	1.38	1.21
Baltimore	1.14	1.14
Boston	1.23	1.23
Chicago	1.50	1.49
Denver	1.25	1.25
Houston	1.26	1.26
Kansas City	1.19	1.15
Los Angeles	1.35	1.32
Miami	1.38	1.38
New Orleans	1.22	1.22
New York	1.29	1.29
Pittsburgh	1.07	1.07
Portland (Ore.)	1.28	1.24
San Francisco	1.35	1.34
Seattle	1.13	1.06

Highway Departments

Region	Current	Previous
I, New England	1.03	1.03
II, Mid Atlantic	1.15	1.15
III, Mid West	1.26	1.29
IV, South	1.12	1.12
V, West	1.13	1.16
VI, Far West	1.16	1.17

Sole purpose of this Index is to show salary trends. It is not a recommended salary scale. Nor is it intended as a precise measure of salary changes. The Index is computed by dividing the current total of base entrance salaries for ASCE Grades I, II, and III by an arbitrary base. The base used is $15,930, the total of salaries paid in 1956 for Federal Grades GS5, GS7 and GS9. Index figures are adjusted semiannually and published monthly in Civil Engineering. Latest survey was December 31, 1960.

ASCE CONVENTIONS

ANNUAL CONVENTION

New York, N. Y.
Hotel Statler
October 16-20, 1961

HOUSTON CONVENTION

Houston, Tex.
Hotel Shamrock
February 19-23, 1962

OMAHA CONVENTION

Omaha, Nebr.
Sheraton-Frontenelle
May 14-18, 1962

DISTRICT CONFERENCES

DISTRICT 7 COUNCIL

Milwaukee, Wis.
August 11 and 12, 1961

DISTRICT 4 COUNCIL

Harrisburg, Pa.
October 7, 1961

TECHNICAL DIVISION MEETINGS

SYMPOSIUM ON WATER RESOURCES AND RECLAMATION

Fort Collins, Colo.
Colorado State University
June 12-15, 1961
Sponsored by
U.S. Bureau of Reclamation
Colorado State University
ASCE

HYDRAULICS DIVISION CONFERENCE

Urbana, Ill.
University of Illinois
August 16-18, 1961
Sponsored by
Hydraulics Division

CONFERENCE ON FUNDAMENTAL RESEARCH IN PLAIN CONCRETE

Monticello, Ill.
University of Illinois
September 5 and 6, 1961
Co-sponsor
Structural Division

AMERICAN ASSOCIATION OF PORT AUTHORITIES CONVENTION

Long Beach, Calif.
September 25-29, 1961
Co-sponsor
Waterways & Harbors Division

LOCAL SECTION MEETINGS

Cleveland—Annual picnic at Euclid Park Clubhouse, E. 222 Street on the shore of Lake Erie, on Friday, July 21. Buffet supper at 6:30 p.m.

Illinois Section—Weekly luncheon meetings at the Chicago Engineers Club (314 South Federal Street), every Friday at 12 noon.

Massachusetts—Summer luncheon meetings at the Hotel Lenox, Boston, on June 21, July 19, August 16, and September 21, at 12:15 p.m.

Sacramento—Weekly luncheon meetings at the Elks Temple every Tuesday, at 12 noon.

St. Louis—Regular monthly luncheon meetings at the York Hotel on the fourth Monday of each month, at 12:15 p.m.

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the fifth of the month preceding date of publication)

A. K. Weber (right), president of the National Capital Section, congratulates Colonel J. H. Kerkering, director of the Engineer Research and Development Laboratories at Fort Belvoir, Va., on his address during the Section's annual dinner meeting.

Hanford Thayer (right), a civil engineer with the U.S. Army Engineer District, Seattle, for the past 18 years, receives his plaque as the Seattle Section's choice for "Civil Engineer of the Year," from Wellington Rupp, retiring president of the Section. Mr. Thayer, incidentally, is himself a past president of the Seattle Section and a current national director of the Society of American Military Engineers.

Dr. Lawrence A. DuBose (left), engineering director of the Testing Service Corporation, receives a plaque from David Novick, the present chairman of the Soil Mechanics and Foundations Division of the Illinois Section, for his part in establishing the Division and for serving as its first chairman.

The advent of the industrial use of fire 4,000 plus years ago was the beginning of air pollution, R. Emmet Doherty, director of Lehigh Valley Air Pollution Control, told the April joint meeting of the **Lehigh Valley Section** and the Lafayette College Student Chapter. Referring to that great "open sewer", the atmosphere, Mr. Doherty indicated that recent investigations of the undesirable effects of air pollution have shown that the tri-pronged nuisance of dust, odors and gases, the approximately $2 billion in damage per year, and the possibility of impairment to health, more than justify an increase in the $500 million spent annually on abatement in the United States. Leadership in this area as well as technical assistance should be forthcoming from an increasing number of civil engineers, according to Mr. Doherty, as they are particularly qualified to find solutions to the air pollution problem.

Fifty members and guests of the **Colorado Section** were on hand to hear J. B. Schijf, director of Holland's Water Resource Development, describe methods employed to effect closure of newly constructed dikes under tidal flow conditions. Judging from the number and variety of questions which followed his talk, Mr. Schijf duplicated his earlier successes at a number of other sections meetings.

The **Soil Mechanics and Foundation Group** of the **Illinois Section** has been conducting a survey on unusual, interesting, or difficult foundation problems in the Chicago area for possible future presentation at one or more monthly meetings. If their efforts are truly successful, they may in addition publish a reference source of information on the soils and foundation conditions in Chicago and its environs. Therefore the Group is anxious to have civil engineers familiar with instances of foundation failures, either where the reason for the failure has been determined or where extensive investigations and theoretical analysis have failed to disclose the reason for the failure, to communicate with William H. Perloff, Chairman of the Foundation Committee, Civil Engineering Deparment, Technological Institute, Northwestern University, Evanston, Ill., preferably in the form of a brief report, albeit one listing all pertinent data. The Group will hold your report in strict confidence, until it receives permission to use it.

Waldo G. Bowman, for many years editor-in-chief of *Engineering News-Record,* has been selected as "Metropolitan Civil Engineer of the Year" by the **Metropolitan Section.** A former Director and Vice President of the Society, Mr. Bowman's selection as the first member of the technical press ever chosen for the award, recognizes the increasing importance to engineers of news exchange media. A case in point, in 1960 he took an extended trip across Southern Asia from Japan to Lebanon and to Egypt's Aswan Dam, and since his return civil engineers and contractors around the world have learned of the construction achievements of this area, so significant politically as well as technically. The presentation was made at the Section's May 17 meeting, at which time new Section President Gardner M. Reynolds, resident partner of Dames & Moore, and new Vice President Arthur J. Fox, managing editor of *Engineering News-Record,* were introduced to the membership. Gordon Wallace, director of design in the Third U.S. Naval District Public Works Office, is the new treasurer, while Brother B. Austin Barry, Manhattan College professor, starts a fourth term as secretary. Also, at this meeting the nine winners of the Robert Ridgway Award received their certificates. It is awarded annually by the Section to the outstanding senior in each of the local student chapters. This year's winners are Herbert I. Blomquist, Polytechnic Institute of Brooklyn; Edward Schmidt, Columbia University; Ira Whitman, Cooper Union; Erwin G. Fruh, Manhattan College; Lewis Sunderland, City College of New York; Gerolemos M. Lastihenos, New York University; John M. Leitch, Newark College of Engineering; Michael Kaplan, Rutgers University; and Jose Sinai, Stevens Institute of Technology.

William R. Bandy received a Life Membership Certificate at a recent meeting of the **Montana Section.** Formerly engineering staff officer for the U.S. Bureau of Land Management with headquarters in Denver, Mr. Bandy is now engaged in private engineering practice at Helena, Mont. Upon retirement in 1955 after 44 years of continuous service with the Department of Interior he was awarded the Gold Medal for Distin-

At the April meeting of the Massachusetts Section, Governor John A. Volpe of Massachusetts spoke on "The Role of the Civil Engineer in Public Service." Seated from left to right at the head table are Paul A. Dunkerley, professor of civil engineering at Tufts University; Charles O. Baird, Jr., professor and head of the Civil Engineering Department at Northeastern University; James F. Brittain, president of the Boston Society of Civil Engineers; Governor Volpe; John H. Fullerton, and William H. Mitchell, respectively Section president and vice president; and Harl P. Aldrich, Jr., Cranston R. Rogers and Donald T. Goldberg of the Executive Committee.

Design and construction features of the modern vehicular tunnel are indicated by an authority in the field, Ole Singstad (seated), to Toledo Section vice president and president, Fred Miller (standing, left) and Leo V. Campbell, at the Section's April meeting. Mr. Singstad was a consulting engineer on such important projects as the Detroit-Windsor Tunnel, the Lincoln Tunnel, and tunnel approaches to the George Washington Bridge.

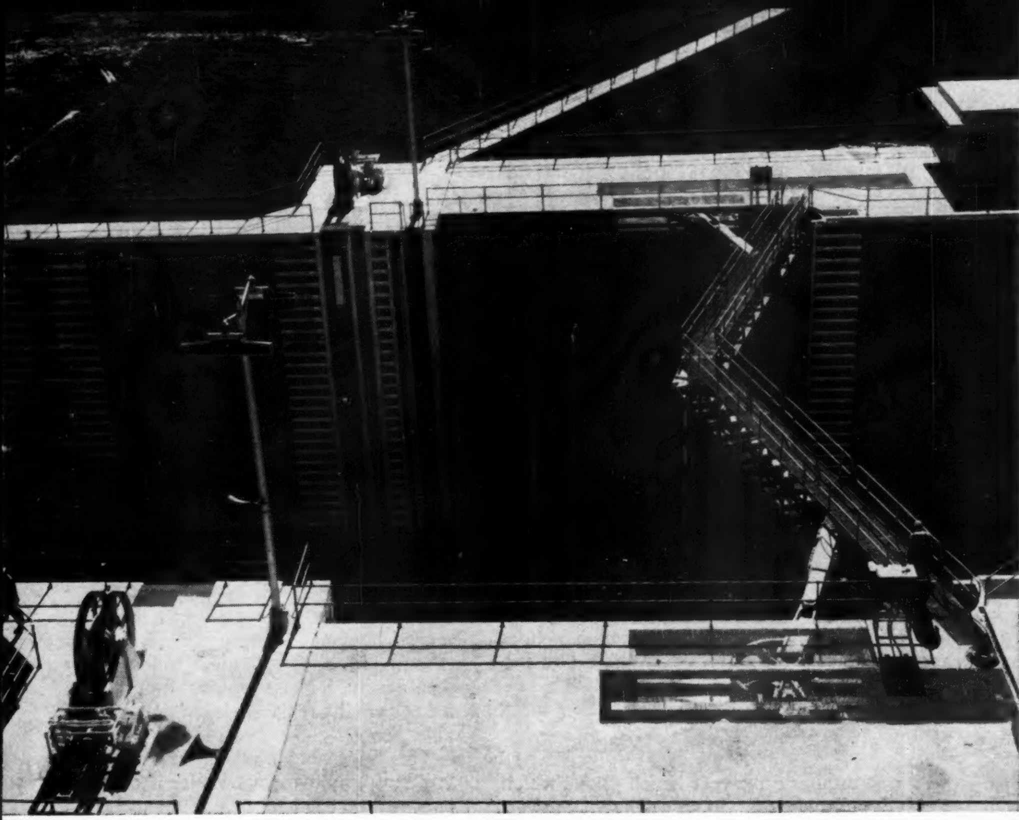
Culminating 2 years of research members of the Southwest Branch of the Nebraska Section gathered recently at a roadside park along Highway 89 in Southwest Nebraska to dedicate a monument to Nelson Buck, government surveyor, and his seven-man party who were massacred by Indians in 1869. Branch members pictured are (from left to right) Paul Berg, Charlie Schuster, Morris Droskin, Bernard Frakes, Dick Brohl, Chuck Maki, Gayle Achterberg, Glen Kirk, Fred Krauss, Jack Reed, Art Soderberg, Raymond Smith, Kenneth Kauffman, Bill Brown, Harold McDowell, Charles Wright and Gilbert Rolliston, who worked with the Nebraska State Highway Department and local historians developing the history preparatory to erecting the monument.

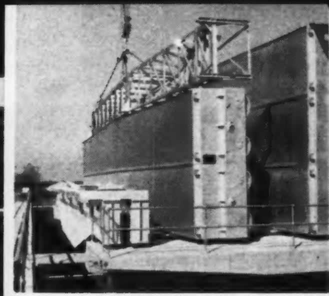
guished Service in the field of cadastral surveys, as an expert in solving problems of ownership of lands bordering on rivers formed by erosion and accretion, and for improvements in corner monumentation.

More than 180 persons attended the annual spring meeting of the **Oklahoma Section** on April 21. On hand for the one-day meeting on "Urban Renewal and the Civil Engineer" were five top civil engineers—all active in urban renewal planning work. James W. Follin, a consulting engineer with DeLeuw, Cather and Company, and first commissioner of Urban Renewal in the Housing and Finance Agency, was the lead-off speaker at the technical session, followed in turn by Frank E. Hawley, assistant planning and research engineer of the Bureau of Public Roads at Fort Worth; Paul Clowers, director of the Oklahoma City Planning Commission; and J. Cal Calahan, director of city planning, with the Morris-Knowles Engineering Company. Luncheon speaker was William D. Hedley, National Vice President of Zone III whose topic was "The Challenge of ASCE." Other activities included presentation of the "Outstanding Civil Engineering Student" award to Larry E. Hove, a senior at Oklahoma State University, and a special luncheon for the ladies at which Lloyd Wright, hat designer, traced the history of ladies' hats from eighty-niner days to the present.

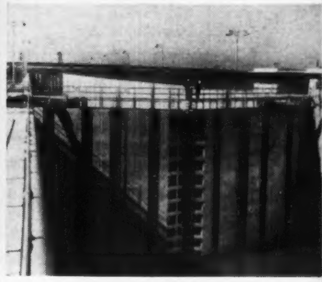
The **Foundations and Soil Mechanics Group** of the **San Diego Section** held an organizational meeting in April. Elected as chairman was Doug Moorhouse of Woodward, Clyde, Sherard and Associates, while Frank Joyce, of Benton Engineering, Inc., was elected as secretary. A program committee consisting of Professor Sanford Stone, Jerry Baker and Dan Ledlay was also formed. The Group which has already presented two programs, listed Professor H. Bolton Seed, of the University of California, as a speaker on "Shear Strength of Cohesive Soils," and Charles Loughridge, district engineer of the American Wood Preserving Institute, on the "Applications of Treated Wood Piles." The Group plans to have quarterly meetings alternating theoretical with applied programs.

Professor Charles E. Behlke, of Oregon State College, in his talk before a recent meeting of the **Oregon Section,** covered a wide variety of hydraulic and other civil engineering structures in West Europe. The differences that exist between those in Europe and in the United States were emphasized by his use of slides. Significant is the problem most European countries have of getting the right materials and consequently the need to find substitutes.

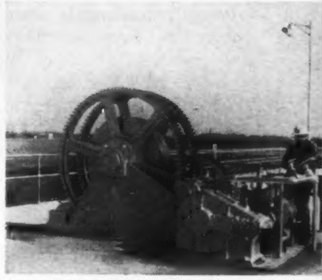




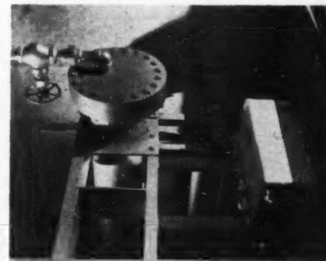
Emergency Bulkhead and Pickup Beam



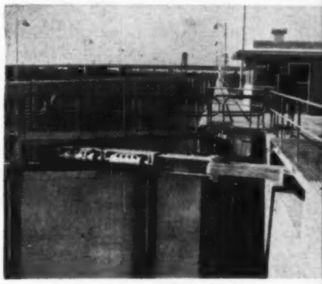
Lock Gates



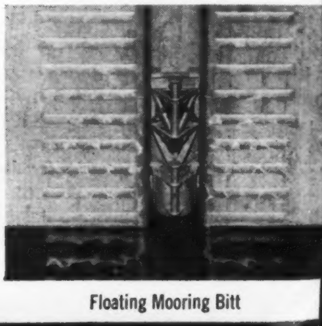
Emergency Bulkhead Hoist



Tainter Valve Operating Machinery



Miter Gate Operating Machinery



Floating Mooring Bitt

THE YOUNGER VIEWPOINT

Committee on Younger Member Publications

Walter D. Linzing, Chairman; 4751 No. Paulina, Chicago 40, Ill.

Zone I	Zone II	Zone III	Zone IV
Donald Kowtko 289 Foxhill Road Denville, N. J.	Albert C. Nelson 250 N.E. 51st Street Miami, Fla.	William R. Walker 4600 Franklin Ave. Western Springs, Ill.	Judd Hull 6000 S. Boyle Ave. Vernon, Calif.

This month's contributing editor is William R. Walker, Zone III representative, who has tackled the problem of getting ahead in the engineering profession. The subject should be of interest to all engineers, especially the young engineer who is looking for guide posts to the future. In order to bring considerable successful experience to bear on the subject, Mr. Walker has asked Richard D. Gleason, career planning counselor, for his advice. Mr. Gleason helped over 60,000 people pick and land good jobs while serving with the New York Man Marketing Clinic. Since starting his own career-counseling organization in 1954, Mr. Gleason has aided some 1,800 executives in finding successful employment.

Getting ahead in engineering

Ask an engineer to design a bridge, and he will methodically lay his plans to accomplish the assignment. But, according to Career Consultant Gleason, when an engineer is faced with planning his career, he often regards it as an insurmountable task. However, he feels that many direct comparisons may be made between designing a structure and designing a career.

Just as designing a superhighway requires careful analysis of the entire route, and then specific plans for constructing each mile of the route, so Mr. Gleason puts emphasis on the total career plan. He believes that engineering is one of the most flexible of professions because it offers so many alternate routes. In addition to straight engineering, there are the alternate routes of construction or manufacturing or sales. For the engineer interested in general management, there are advantages in getting experience in each of these areas.

Mr. Gleason advises that one of the best ways of getting ahead is to establish a career plan that fits a long-term objective. The engineer should then subdivide his career into five-year goals or milestones to indicate where he should be at each five-year point in his career.

Many engineering organizations put great stress on curves showing average income based on years out of college. According to Mr. Gleason, this is wrong because it tends to make an engineer "average" his measure rather than strive for the highest. In other words, instead of making an income curve his objective, he should establish five-year bench marks which, if achieved, will go a long way toward helping him exceed the average.

Once five-year goals are established, the engineer should determine the job requirements of the next level he is seeking. Knowing these requirements, he then can make plans either to try to get on-the-job experience or additional formal training, whichever the situation requires.

A decision which every engineer should make as early as possible in his career is whether his direction should be design, manufacturing, construction, sales, or another of the engineering-oriented activities. In addition, for some of the fields, he must decide whether he is temperamentally best fitted for line production or staff service responsibilities. If his objective is line, then he should endeavor to make line positions his bench marks and learn as much as possible about the staff responsibilities by observation rather than taking the time to concentrate on them as full assignments and thereby run the risk of diverting his true aim.

Many years ago, when a man had general management as his career objective, Mr. Gleason points out that it was common for him to spend a few years each in various segments of general management, such as engineering, manufacturing, sales, finance, and personnel. However, each move under such a plan was more likely to be a lateral move rather than steps up a ladder. Therefore, the more common tendency now is for a person to establish his primary goal and a primary route and then to learn the additional facets as adjuncts to his main line of endeavor.

The time-table factor also is important because it not only times a man's progress but gives him measurable periods during which he can prepare for the next steps in his advancement. Similarly, finding out what each job requires not only helps define the path but it develops a form of "market research" as to the avenues of progress available and whether the individual really is interested in and will enjoy that route.

A paradox of the current economic recession, which Mr. Gleason has noted, is that it actually is providing more opportunities for able executives. In normal times, when things are going well, management is inclined not to "rock the boat" by changing any of the executives. But when things begin to get rough, management scrutinizes each executive to be sure he is "pulling his own weight." Those who are not, are being rapidly replaced by more capable people.

This is even affecting secondary levels of employment because it often happens that when management begins to look at one key operation it finds that the top man has intentionally avoided having a strong assistant pushing him too hard from behind. The result is that a number of companies are finding it necessary not only to put in a new top man, but to find a stronger assistant.

Still a third phenomenon of the recession has been the necessity of improving the organizational structure of a business. For example, a large company which had grown so rapidly that it had not paid sufficient attention to this aspect of its functioning found it necessary to hire a good organization man away from its competitor who was well known for good organization. Mr. Gleason points out that engineers can use all three of these recession-born phenomena to advantage in furthering their own career objectives.

In summary, his recommendations are:

1. Set a long-term career objective with five-year road markers.

2. Learn all you can about the requirements of each job ahead. Then prepare carefully for each upward step.

3. Analyze your qualifications in relation to each of the job requirements.

4. Keep yourself sold just as you would if selling a product.

This not only applies to seeking a new position but it is equally important that your current boss should know of your qualifications to do the job ahead.

BY-LINE WASHINGTON . . . . .

An important **concession to consultants** who serve the federal government is contained in a little-noted passage of President Kennedy's message on "ethics in government." It would permit such consultants to do business with the government as private individuals (or firms)—even with the agencies which they have served. The President's reasoning (in accompanying suggested legislation): Barring such men from government contracts, because of interpretations of conflict-of-interest statutes, is a "severe and unnecessary penalty for contributing to public service." Consultants would be barred from government contracts only "with respect to transactions in which they participated, personally and substantially, during their government service."

There were several other **questions of ethics** bouncing around Washington in mid-May. For one thing, professionals were beginning to express real concern that heavy-handed censorship of articles in professional military journals—in an attempt to cut out conflicts with foreign policy—could shut off exchange of scientific ideas. Whole issues of Army, Navy and Air Force service journals reportedly have been decimated by deletions of articles because of a single reference to relations with other nations.

* * *

It should be noted that **compromise has been the order of the day**—neither the President nor his opposition has succeeded in obtaining what had been originally proposed. On highways, for example, Mr. Kennedy got a jump in weight-taxes on trucks, didn't get a raise in taxes on truck fuels. He did get continuation of the 4-cent tax on gasoline, didn't get the extra half-cent that both he and former President Eisenhower had requested. He did get firm Congressional commitment of appropriations for Interstate Roads up to 1973, but had to accept a continued diversion of $150 million from the treasury to keep the Trust Fund on an even financial keel.

* * *

On **stream pollution** (to which there was little real opposition in the House) the Administration got $100 million a year for loans for pollution-control works. It didn't get an immediate transfer of the control program to an engineer-oriented Administration of its own (instead, the House approved taking the program away from the Public Health Service, but left it to Secretary Ribicoff to decide what to do with it.)

* * *

On **depressed areas,** the Administration got its program, substantially as requested, but had to bow to Congressional insistence that the program be operated under the Department of Commerce, rather than under an "independent" agency organization. It won its point that $300 million could be borrowed from the Treasury (without Congressional review) to finance loans and grants, but had to agree to a requirement that the Commerce Department must exhaust all existing agencies and staffs now working in this area, before setting up an elaborate organization of its own.

The aura of compromise even extended to much of the **legislation** that was still in the proposed stage at mid-May—Senator Monroney's $75 million, five-year airport construction bill was a good example. Monroney had announced he would plump for a $100 million-a-year, four-year program. Certainly, if Congress approves a school-aid bill (and the odds, though nearly even, still favor it), it will represent a series of major compromises. Any chance at all for a Department of Urban Affairs (still considered slim) must also rest on much trading. The proposals for tax incentives to business to stimulate construction also face stiff opposition.

* * *

A new attempt to get the long-delayed **"third locks"** program going again for the Panama Canal—and to kill off the sea-level canal idea—is embodied in HR 6296, introduced by Rep. Daniel J. Flood (D. Pa.). It's an exact duplicate of a bill introduced last year, would set up an 11-member Interoceanic Canals Commission, including three military men and eight civilians—four of whom "shall be learned and skilled in the science of engineering" to study the canal and its needs. Flood's objections to a sea-level canal: It would require a new treaty with Panama and probably added U. S. concessions as to control of both the new and existing waterways.

* * *

The Air Force is using a newly-developed **photoelectric cell computer** to test runway smoothness at airbases, to produce data needed for designing landing gears, fuselages, and other aircraft components affected by rough landings. Measurements are taken with two electronic photoelectric cell-computer carts, one housing a cell which transmits a light beam horizontally across the runway surface. Cells in the second cart record the runway profile on paper tape for later study and evaluation.

* * *

There were two bills of importance to the **highway program** still to be considered by Congress: One (by Rep. Cramer, R. Fla.) would require Congressional approval before any toll facility was included in the Interstate System; the other (by Senator Neuberger, D. Ore.) would extend billboard control features by continuing the offer of extra money to states which accept standards for billboard controls.

* * *

Any work for U. S. engineers and contractors that may be generated by the President's $500 million **aid program for Latin America** will move through established channels, and will be slow in coming. That much was clear as the Senate opened debate on the program early in May. The U. S. funds would be distributed through the Inter-American Bank ($394 million); International Cooperation Administration ($100 million), and the Organization of American States ($6 million), and will be subject, in general, to the rules of these organizations in making loans to foreign countries. The bill also contained a provision that loans could be made to certain "iron curtain" countries, such as Poland, where there would be no opportunity at all for U. S. engineers or contractors.

Progress Report on

STEEL CONSTRUCTION

JUNE, 1961

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

Two New 'Scrapers for the San Francisco Skyline

That's the International Building in the foreground, shown just after topping-out by a Bethlehem erection crew. The finished building will be a beauty, twenty-two stories high. And note how the floors cantilever out from the column perimeter, providing an extra column-free sixteen feet on all four sides. The job required 4,074 tons of structural steel, fabricated by Bethlehem, and connected in the field with 113,500 A-325 bolts, and 9,500 extra-high-strength bolts.

Owner: Natomas Company; *architect:* Anshen & Allen; *structural engineer:* John J. Gould & H. J. Degenkolb—Robert D. Dewell; *general contractor:* Dinwiddie Construction Co.

In the background, high on Nob Hill, stands the 29-story addition to the Fairmont Hotel. It, too, was fabricated and erected by Bethlehem, and was topped out late in 1960. Its 22-story tower springs from a massive, 7-story steel-framed base providing a three-level parking garage, a convention and exhibit hall, dancing pavilion, and delightful gardens. The structure contains 3,089 tons of structural steel, field-joined with some 92,000 A-325 bolts.

Owner: Fairmont Hotel Company; *architect:* Mario Gaidano; *structural engineer:* H. J. Brunnier; *general contractor:* Haas and Haynie Corporation.

Unique Steel Frames for Washington, D.C. Stadium

BETHLEHEM STEEL

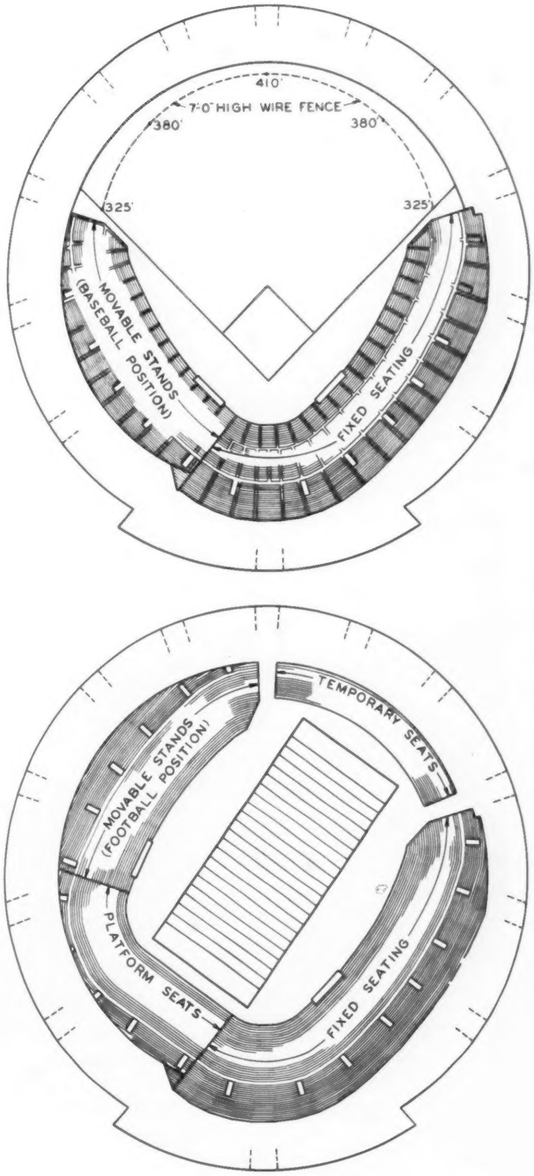
WASHINGTON, D.C.—A total of sixty-six giant steel frames will support the roof and upper-deck seating for the new District of Columbia Stadium.

The upper cantilever arm's 70-ft reach will support roofing to shelter a major portion of the seating. The lower cantilever, varying up to just over 60 ft in length, soars out over lower-level seating, avoiding any need for obstructing columns. Every seat in the "house" has a clear view of the playing field; capacity is 43,500 for baseball, 50,000 for football.

The nature of the job required that Bethlehem use erection equipment with unusually long reach. What you see here is a 35-ton-capacity stiffleg derrick (44-ft mast and 90-ft boom plus 15-ft jib) mounted on an 85-ft tower traveler movable over temporary tracks. An 80-ton-capacity crawler helps out. It has a 140-ft boom with 30-ft jib.

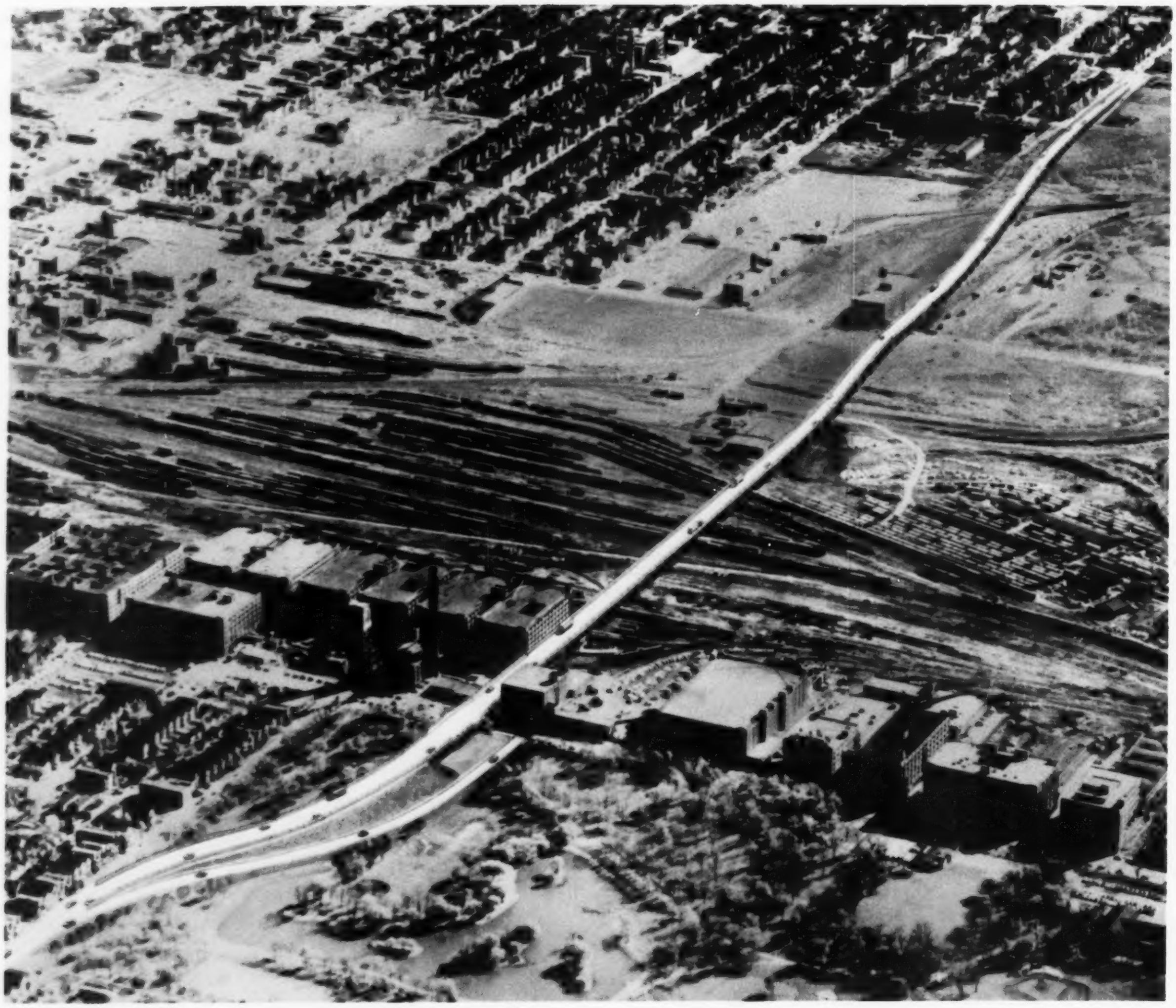
All sixty-six frames are of box design, combining great strength with neat appearance. They were shop-welded, using Bethlehem plates meeting ASTM A373, ranging in thickness from ⅝ in. to 1¾ in. The lower frame arm is readily identified by the seat brackets welded to its upper face. At the job site the assemblies were placed, in most places without falsework, temporarily fitted up, and later finish-welded in position. Located at about 30-ft intervals, the frames are supported laterally by welded box struts, welded into position, and wide-flange roof beams connected with high-strength structural bolts.

Owner: District of Columbia Armory Board; *architects and engineers:* Dahl-Erwin-Osborn. McCloskey & Co., Builders.



Sketches show how the movable, 340-ft-long seating section works. This arrangement puts 80 per cent of the seats along the foul lines for baseball and 50 per cent along the sidelines for football.

Typical section clarifies the stadium's novel design. Radius is 348½ ft to center of the outside column line. Maximum height from the playing surface to roofline is nearly 100 ft. Note the press box and mezzanine seating, suspended under the upper tier seats, and the movable stands on tapering, truss-like supports.



Artist's rendering of bridge superimposed on aerial photograph. From bottom, the new road crosses a corner of McKinley Park on fill, proceeds as a viaduct south over Pershing Road, through the Central Manufacturing District, over the railroad yards with minimum clearance of 22 ft, over 43rd Street and industrial spur lines, and back to grade at 47th Street.

We've Been Working Over the Railroad

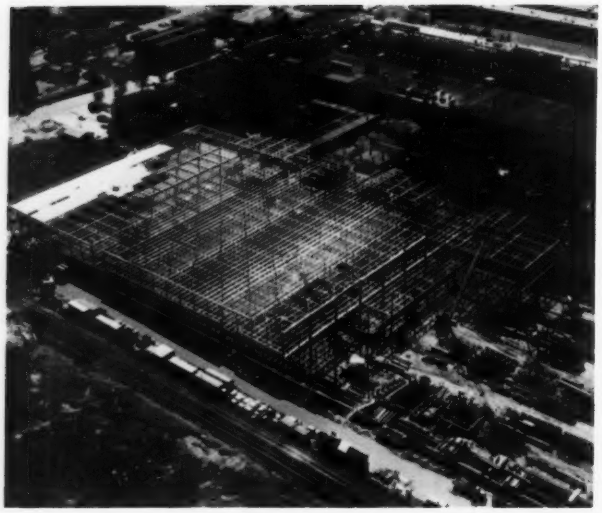
CHICAGO—As every local motorist knows, you can't go very far in any direction without encountering a railroad right-of-way. Providing structures to move traffic over or under these formidable obstacles has always been a major concern of the City's Department of Public Works.

The last remaining obstructed portion of Damen Avenue, the stretch from West 37th Street to West 47th Street, is slated to be opened in November as a main traffic artery. This will mark completion of what is known as the South Damen Avenue Improvement, 6,700 ft of road construction, including a 4,750-ft viaduct.

The viaduct is where Bethlehem came in. As superstructure contractor, we began erecting steel for the multi-span elevated highway early in the year, and since that time have literally been working "over the railroad." Total structural steel requirement is roughly 9,000 tons, including both simple-beam spans and a large number of long and hefty continuous plate-girder spans.

Handling a great many pieces of steel within the busy Chicago Junction Railway Yards required careful scheduling of work, as well as the cooly efficient erection procedures you would expect of a thoroughly experienced organization. Equipment used on the job includes an 80-ton-capacity crawler, a 75-ton-capacity locomotive crane, and a traveler set up on the roadway.

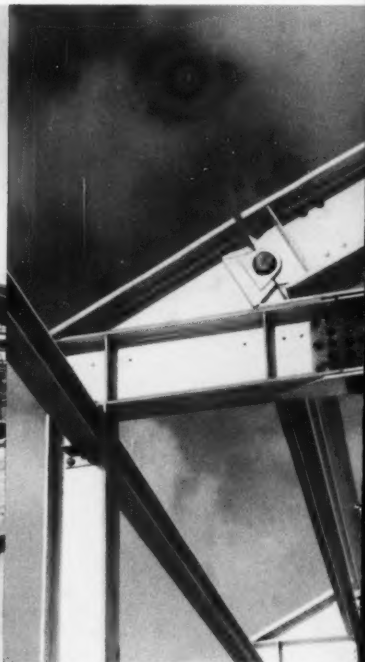
Engineering design, field engineering, and construction work is handled by the Division of Bridges and Viaducts of the Bureau of Engineering, Department of Public Works. *Consulting engineer:* A. J. Boynton and Company; *contractor for viaduct substructures:* James P. McHugh Construction Company; *general contractor for approaches:* J. M. Corbett Company.



Chevy Expands in Baltimore

BALTIMORE—Slanting rays of the sun highlight the steelwork for a portion of a new addition nearly doubling the size of the already huge Chevrolet-Fisher Body plant. The job required a high-strength-bolted framework of approximately 7,100 tons of structural steel, fabricated and erected by Bethlehem.

Owner: Chevrolet Motor Division, General Motors Corporation; *engineer:* George H. Miehls—Albert Kahn Associated Architects and Engineers, consultants; *general contractor:* Consolidated Engineering Company, Inc.



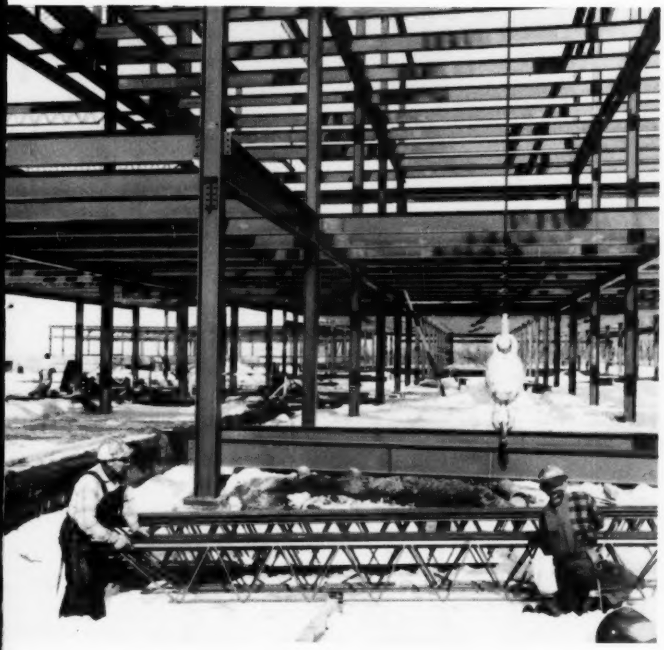
A pin connector, high-strength bolts, and welding were used in the arch-to-column connections.

Tied Arches to Span 97 Ft

JOHNSTOWN, PA.—Up goes one of seven two-hinged tied arches for Pennsylvania Electric Company's new storage and line building. Thanks to their 97-ft span, there are no obstructing columns within the building's 300-ft-long floor area. The arches (24 WF 94) rise 13 ft above the chords (18 WF 55 up to 18 WF 85), and will be exposed above the roof of the completed building.

This structure is but one of a complex of facilities for the utility's new system headquarters and divisional service center in Johnstown. All the buildings are framed with structural steel, fabricated and erected by Bethlehem. Largest of all is the headquarters building, 220 ft long and four stories high, plus a two-story wing. It is planned as a model of efficiency and comfort, with electricity supplying the power for a combination heating, cooling and air-cleaning system, and snow melting.

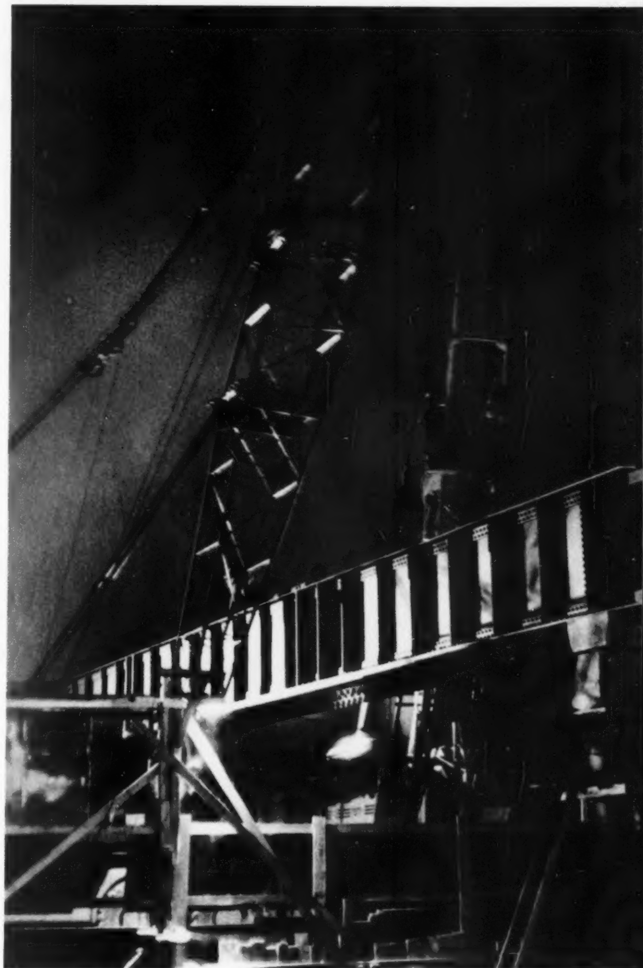
Owner: Pennsylvania Electric Company; *architect:* Lacy, Atherton and Davis; *structural engineer:* A. W. Lookup Co.; *general contractor:* Sordoni Construction Co.



Steel for Space Study

VALLEY FORGE, PA.—Nearly two hundred years ago a rugged winter earned this community an indelible spot in the history of our country. The weather was equally severe last winter. But snow on the ground and sub-freezing air didn't prevent Bethlehem ironworkers from speeding ahead with steel framing for General Electric Company's $30 million Space Technology Center—research and development laboratories for the Missile and Space Vehicle Department. The 800,000-sq-ft facility is 17 miles west of Philadelphia, just off the Pennsylvania Turnpike on a 130-acre site.

Credits for various phases of the work: United Engineers and Constructors, Inc. (engineering and architecture); Vincent G. Kling (architecture); Jackson & Moreland, Inc. (engineering).



Big Box Girder for Bus Station

NEW YORK CITY—Ever see a building component as massive as this one? It's 150 ft long, and weighs a solid 205 tons. It is one of the four box girders for the George Washington Bridge Bus Station in New York City. They span Fort Washington Avenue, supporting the ramps between the station and the bridge.

The bus station extends for two city blocks on three levels, and requires 5,770 tons of structural steel, all fabricated at Bethlehem's Pottstown Works, and being erected by Bethlehem crews. Trans-bridge buses will be using the huge new facility beginning in summer of 1962.

Owner: The Port of New York Authority; *designed by:* Port Authority engineers. These box girders are part of the structure which supports the unique roof over the Bus Station, designed by Dr. Pier Luigi Nervi.

News Briefs . . .

Repairing Mississippi Lock for Spring Shipping

Years of wear and weather forced repairs this winter of Mississippi Lock No. 1 near Minneapolis. Under the supervision of the U. S. Corps of Engineers, a program of substantial repairs to the concrete structure was placed on a rigid time schedule that would assure reopening of the lock in time for the spring shipping season. This meant that most of the concrete construction must be performed during the Minnesota winter, when temperatures normally range downward from 40 deg above to 15 deg below zero.

Original plans called for driving sheetpiling to reinforce the base structure of the lock. Soil conditions did not permit this, however, so as an alternative, additional sections of reinforced concrete were added. A concrete adhesive compounded with a base of Thiokol polysulfide polymer was specified as the bonding agent between the new and existing concrete.

A second phase of the reconstruction project involved the erection of additional vertical columns to reinforce the side walls of the lock. In this instance, Thiokol polysulfide-base adhesive was employed for grouting steel dowels into the existing walls to serve as a tie between old and new concrete units.

Because of low-temperature conditions, the contractor, the Ashbach Construction Company, of St. Paul, enclosed the concrete-pouring area in a framework covered by polyethylene film. Propane heaters raised the temperature of the enclosed areas to 60, or even 75 deg, suitable for placing concrete and for using the polysulfide polymer-base concrete adhesive.

On the base structure, adhesive was applied to the surface of the existing concrete slabs where they joined the new concrete sections. The adhesive was brushed on after reinforcing steel was installed and, immediately afterwards, the new concrete was poured and finished according to standard procedures. The adhesive provides a bond that makes the new cured concrete essentially one continuous structural unit with the old sections.

For grouting dowels into vertical walls, adhesive was combined with dry sand, in a 1:1¾ ratio, and forced into drilled holes by an air-operated auger. Dowels inserted into the grout-filled holes became tightly bonded within 24 hours. With the dowels secure, the new concrete columns were poured in place, enclosing the dowels and forming a strong, unified structure.

Inside the enclosure, dowels of reinforcing steel were grouted into the existing framework at the base of the lock. Wellpoints prevented uplift pressure under the base while the lock was dewatered.

Contract for Prestressed Concrete Reservoir

A contract to prestress what will be the world's largest prestressed concrete reservoir has been awarded to the Preload Company, Inc., of New York. The 28,000,000-gal unit, to be constructed for the Alderwood Water District Commissioners at Alderwood Manor, Snohomish County, Washington, will have twice the capacity of the present largest reservoir of this type. It will be 370 ft in diameter and 27½ ft high, unroofed and with a "dished" bottom. The cost will be about $600,000.

Consulting engineers on the project are Gray & Osborne, of Seattle and Yakima, Wash. Rasmussen & B-E-C-K, of Seattle, are the general contractors. Their bid was less than 1 percent lower than the two nearest bids on the prestressed concrete design, but more than 20 percent lower than the lowest bid based on steel construction.

Plans Speeded for Missouri River Cleanup

Recent passage of a $5,955,000 bond issue by St. Joseph, Mo., removes the major remaining barrier to the success of a federal-state program to clean up the Missouri River. The bond issue was approved by a vote of 10,502 to 3,789.

In announcing passage of the bond issue Abraham Ribicoff, Secretary of Health, Education, and Welfare, remarked that "When the Missouri River has finally been cleaned up, it will not only be a major national asset but a fine example of the effectiveness of the Federal enforcement program in the control of water pollution."

The recent election came after the Federal Government had brought suit against the city for its pollution of the Missouri. The suit, the first of its kind ever brought by the government, was filed under the enforcement provisions of the Federal Water Pollution Control Act. Suit was brought at the request of the Kansas State Board of Health and with the concurrence of the Missouri Water Pollution Control Board.

Studies begun nearly four years ago had revealed that wastes from the city and eighteen industries in the St. Joseph area were causing serious pollution of the river. The industries subsequently agreed to take steps to treat their wastes but the residents of St. Joseph twice refused to do so, voting down one bond issue for the purpose in 1958 and another in 1960. All other cities along a 1,000-mile stretch of the Missouri have complied with Federal directives.

Contract Awarded on Barkley Dam Project

A $2,339,745 low-bid contract for construction of a cofferdam for the powerhouse section of the giant Barkley Dam on the Cumberland River has been awarded to the Dravo Corporation, Pittsburgh, by the Army Corps of Engineers. The contract, which also encompasses part of the dam, will involve erection of 22 interlocking, 59-ft-dia steel sheetpile cells, forming a 1,200-ft-long, watertight chamber inside which the powerhouse will be built. It will also include 1,400,000 cu yd of excavation. Work on the cofferdam will begin about June 1, with completion scheduled for late this year.

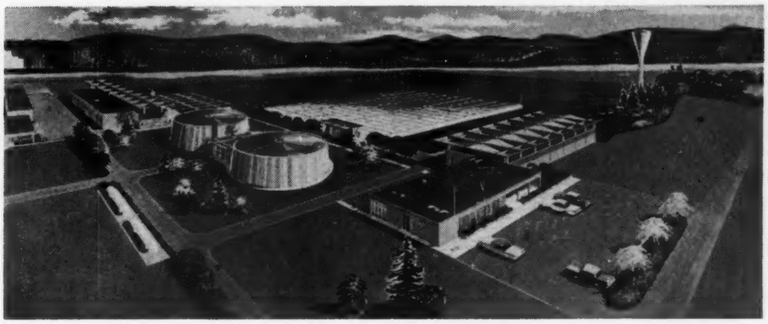
Located about 30 miles up the Cumberland River from its mouth at Smithland, Ky., Barkley Dam is a multi-purpose project (flood control, navigation, and hydroelectric power), which will cost an estimated $182,000,000. The powerhouse, to be built near the center of the two-mile-wide dam, will be equipped with four generating units having a combined capacity of 130,000 kw. Electricity generated will be distributed by the Southeastern Power Administration through the facilities of the Tennessee Valley Authority.

More than 150 feet high at its highest point, the dam will replace five existing smaller dams and will form a reservoir in the Cumberland River over 118 miles long. The reservoir, to be known as Lake Barkley, will extend beyond Clarksville, Tenn., to Cheatham Dam, completed by Dravo for the Corps of Engineers in 1954. An unusual feature of the project will be a connecting canal between Kentucky Lake on the Kentucky River and Lake Barkley, so that flow in either river may be regulated by changing the flow of the canal.

Construction Rises Seasonally in April

New construction put in place in April amounted to $4.3 billion, according to the Bureau of the Census of the U.S. Department of Commerce. This amount represented a 10 percent rise over spending in March—the normal seasonal change for the period—and a 3 percent rise above the April 1960 level. Making up the April total were private construction expenditures of $3 billion and public expenditures of $1.3 billion. Spending for private construction was at the same level as in April 1960, whereas public construction expenditures were 12 percent above last April.

Total spending in the first four months of this year amounted to $15.7 billion, compared to $15.5 billion in the same period of 1960. During the four-month period spending for private construction declined 3 percent, while total public construction expenditures increased 16 percent.



Vancouver Builds Automatic Sewage Treatment Plant

The $11,000,000 Iona Island Sewage Treatment Plant, commissioned by the Greater Vancouver Sewerage and Drainage District, will be a model of self-sufficient operation. Sludge gas produced from the plant's sludge digesters will fire the engines that operate the plant, with the result that only about 18 men will be needed for round-the-clock operation and maintenance. In case of failure in the gas system, the engines have an automatic switchover and can be operated on diesel fuel. The plant is designed for primary treatment of sewage, with provision for the addition of secondary treatment facilities later. It will handle both sanitary and storm water flow. When the first stage is completed late in 1962, it will serve up to 320,000, people. With later installations, it will ultimately handle a peak flow of 340 mgd from a tributary population of 640,000. The engineering design was by Brown and Caldwell, of San Francisco, and Crippen Wright Engineering Ltd., of Vancouver. The main contractor for construction of the plant is Perini Pacific Ltd., on an adjusted bid of $4,674,765.

World Traffic Conference To Meet in Washington

Members concerned with highway and traffic problems (and who isn't these days?) will be interested in the First World Traffic Engineering Conference, to be held in Washington, D.C., August 21-26. Over 1,000 delegates from all over the U.S. and abroad are expected. Russia, Japan, Australia, and New Zealand, as well as the countries of Western Europe and Latin America, are planning to participate.

The conference will include the 31st annual meeting of the Institute of Traffic Engineers and an International Study Week in Traffic Engineering, plus a week-long bus tour of highway facilities and traffic control devices in the Middle Atlantic and New England states. Also in prospect is a seminar for traffic experts from the 21 countries of the Americas under sponsorship of the Organization of American States—Pan-American Union.

The sponsoring organizations are the Institute of Traffic Engineers and the Joint Committee on International Weeks for Traffic Study. The latter is made up of representatives of the World Touring and Automobile Organization, the Permanent International Association of Road Congresses, and the International Road Federation. The opening three days of the conference will be devoted to the annual ITE meeting and the final three to international sessions. The ITE meeting will close with a reception and banquet on August 23.

The theme, "Objectives in the Development of Metropolitan Areas," will be developed on the opening day of the ITE meeting. Experts will discuss the social, political, economic, planning, and architectural implications of this topic. During the following two days there will be concurrent sessions of the ITE Departments on Administration, Application of Devices, Planning, Operations, Design, and Equipments and Materials.

During the three days of international sessions six themes will be developed. They are: "The Need for Scientific Research in Traffic Engineering and the Desirability of International Cooperation in Promoting It"; "Urban Transportation and Its Future"; "Design of Interchanges on Rural Freeways"; "Research Into Highway Traffic Accidents"; "Use of Electronics in Traffic Control"; and "Freeway Operation." Speakers from fifteen nations are scheduled to appear in these sessions.

There will be simultaneous translation of the proceedings into four languages—English, Spanish, French, and German—through the cooperation of the State Department and the International Cooperation Administration.

More detailed information is available (in the U.S.) from David M. Baldwin, Executive Secretary, Institute of Traffic Engineers, 2029 K St., N.W., Washington 6, D.C., and (in Europe) from H. M. Perlowski, World Touring and Automobile Organization, 32 Chesham Place, London S.W. 1, England.

ASCE Member Made New Chief of Engineers

On May 19, Maj. Gen. Walter K. Wilson, Jr., F. ASCE, took office as the new Chief of Engineers, U.S. Army. General Wilson, who also has Senate confirmation for promotion to the rank of Lieutenant General, has recently been Commanding

General, U.S. Army Engineer Center, Fort Belvoir, Va. In the Corps of Engineers since his graduation from West Point in 1929, he has filled a wide range of assignments as district and division engineer. He has also been Assistant Chief of Engineers for Military Construction and Deputy Chief of Engineers for Construction. During World War II he commmanded the 79th Engineer Combat Regiment and was Deputy Engineer in Chief with the Southeast Asia Command in India and Ceylon.

National Watershed Congress Cites Best Water Projects

Watershed projects in Virginia and Louisiana were cited as the best being completed in 1961 by the Eighth National Watershed Congress, held in Tucson, Ariz., late in April. The two projects are the Mountain Run Watershed of Culpeper County, Virginia, and the Upper West Fork of Cypress Bayou Watershed in Bossier Parish, Louisiana.

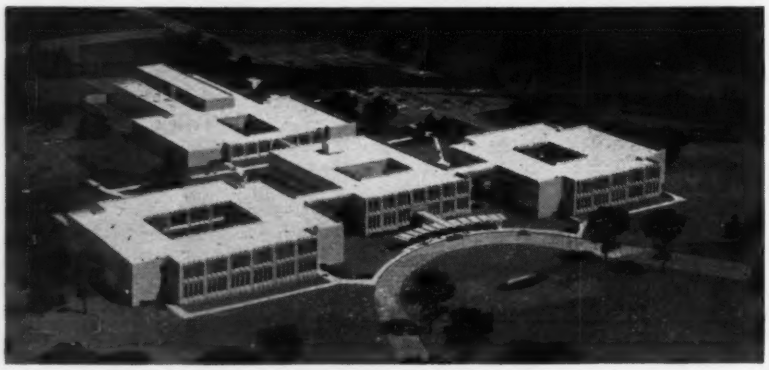
Sponsors of the Mountain Run Watershed, which has been under construction for the past five years, are the Culpeper Soil Conservation District and the Town of Culpeper. The Dorcheat Soil Conservation District and the Town of Plain Dealing are the sponsors of the Cypress Bayou Project. Both were praised for having enlisted a high degree of local interest and participation, as well as for their achievements in flood protection and in water-resource conservation.

John S. Wilder, of Somerville, Tenn., was named "Watershed Man of the Year" in recognition of his "consistent and effective work . . . to advance the principles of multiple-use resources improvement through the watershed program . . . for effective grass-roots leadership in securing better public understanding of the national watershed program."

The Tucson meeting brought together representatives of the nation's leading agricultural, industrial, business, and conservation organizations for study of the country-wide problem of halting erosion and stabilizing water flow in upstream tributary areas. It is in these areas that more than half the annual flood damage occurs.

Rutgers University to Have New Engineering Center

Rutger's biggest single building project—a $5,450,000 engineering center consisting of four connected buildings—will be started this summer. With 177,000 sq ft of floor space, the new center will enable the college to double its present engineering enrollment of about 700 students. It is designed for future expansion to accommodate the entire engineering college and an anticipated 1970 enrollment of about 2,500. The central unit in the cluster of four will be linked to the others by masonry and glass passageways. Three of the units will be two stories high, and the fourth a one-story structure with two-story bay to accommodate an overhead traveling crane. The architect-engineer is Frank Grad & Sons, of Newark, N. J.



Site Selected for New TVA Steam Plant

The Tennessee Valley Authority will have a new steam plant, to be built on the outskirts of Oak Ridge, Tenn., on a site known as Edgemoor. Plans for the $125,000,000 plant have been delayed, pending the outcome of a dispute between Tennessee and Kentucky. Both states wanted the plant, and President Kennedy had asked the TVA to consider the chronic unemployment in the coal areas of eastern Kentucky in choosing a site. The 900,000-kw plant will use 2,000,000 tons of coal annually.

However, spokesmen for the TVA had asked the President to withdraw his request on the ground that the board should be left free to continue to select plant locations "solely on the basis of engineering and technical considerations."

Long Beach to Have New Municipal Pier

One of the largest municipal harbor piers in the world, Pier A at the Port of Long Beach, will soon be dwarfed by a new pier which is being planned by the Long Beach Board of Harbor Commissioners.

Pier A, the present record holder, is 7,600 ft long and has eleven berths. It covers 250 acres of man-made land. The new installation, to be designated Pier J, will be 12,700 ft long and will include 311 acres and eleven berths. Over 33,000,000 cu yd of fill material will be dredged from the Outer Harbor to construct the huge peninsula.

Some 110 acres of the pier site not needed for shipping will be devoted to tourist attractions, including restaurants, hotels, motels, and parks. The total cost of the new pier project will be $81,000,000, to be borne by the Long Beach Harbor Department, and $14,000,000 by private interests. It is expected that the pier will be open to shipping in 1966.

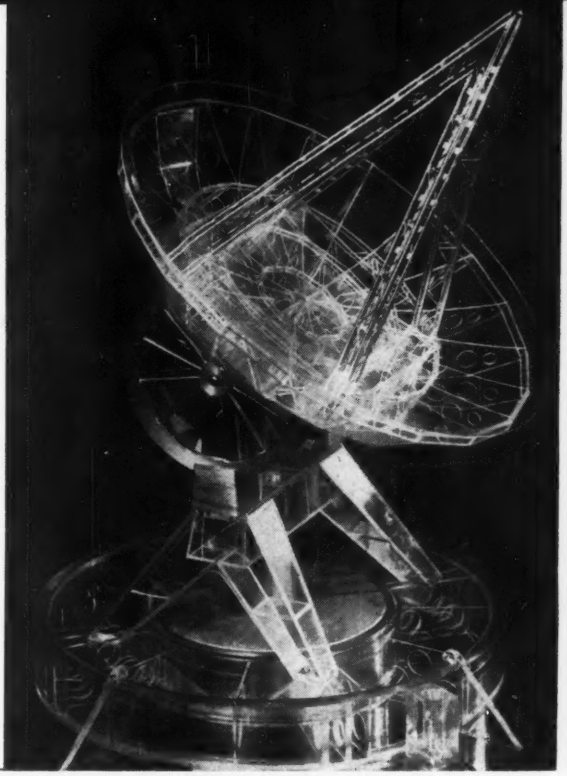
Tunnel Connecting Spain And France Under Study

A vehicular tunnel connecting France and Spain under the Pyrenees is under study by the two countries. The 1.5-mile tunnel would link Benasque in the Huesca Province of Spain with Luchon in the French Department of Haute-Garonne. The project would reduce driving distance between the two cities from 100 to 17 miles.

The Government of Spain, which proposed the tunnel, has approved the expenditure of $1,000,000 for work on a six-mile connecting highway between Benasque and the entrance to the proposal tunnel. If France endorses the tunnel, it will build a four-mile highway from Luchon to the tunnel portal on its side.

Missile-Tracking Device Designed for Air Force

For the U.S. Air Force Cambridge Research Laboratory, Ned L. Ashton, F. ASCE, consulting engineer of Iowa City, has designed a 300-foot-dia radial telescope that floats yet all parts are held within 1/8 in. of design location. The floating portion of the structure (shown here in scale model) would weigh 36,000,000 lb and be supported on a 20-ft-deep circular barge within a 280-ft-dia shell. Water pressure will hold the movable portion firmly against anti-friction bearings under the rim of the outside shell. The device would be 435 ft high with 12,000,000 lb of its weight above the geared declination bearings. Design criteria included meeting 200-mph winds and an unbalanced 8-in. ice load. Electronically controlled push-pull jacks within trusses will adjust the solid surface parabolic reflector to meet changing conditions. The model was built by the Electric Boat Co., of Groton, Conn., a division of General Dynamics.



New Officers for NSPE

Murray A. Wilson, F. ASCE, consulting engineer of Salina, Kans., has been elected president of the National Society of Professional Engineers for the administrative year which begins in July. Six area vice presidents have also been elected: W. Earl Christian, M. ASCE, New Brunswick, N.J., Northeastern Area; Harvey F. Pierce, Miami, Fla., Southeastern Area; Waldo W. Wegner, Cedar Rapids, Iowa, North Central Area; C. Raymond Hanes, Columbus, Ohio, Central Area; Thomas T. Mann, F. ASCE, Roswell, N. Mex., Southwestern Area; and John H. Stufflebean, F. ASCE, Tucson, Ariz., Western Area. Russell B. Allen, Silver Spring, Md., has been reelected treasurer for a 14th term.

Lief J. Sverdrup, F. ASCE, president and director of the St. Louis engineering firm of Sverdrup & Parcel, Inc., has been selected to receive the 1961 NSPE Award for outstanding service to the engineering profession. Formal presentation of the award to Mr. Sverdrup and installation of the new officers will take place during the annual meeting of the NSPE in Seattle, July 4-7.

Moles Elect New Officers

Harry T. Immerman, F. ASCE, vice president and chief engineer of Spencer, White & Prentis, has been elected president of The Moles, a New York City association of heavy-construction engineers and executives. Mr. Immerman, a resident of Larchmont, N.Y., was The Moles Member Award winner for 1961. Associated with Spencer, White & Prentis since 1923, he has provided solutions to a multitude of difficult foundation, underpinning, and shoring problems. As first vice president of The Moles, elected a year ago, Mr. Immerman has actually been top officer of the organization since the death last September of Chester W. Cambell, F. ASCE, the 1960 president.

Other new officers elected are: Eugene G. Rau, F. ASCE, of J. Rich Steers, Inc., first vice president; Howard G. Dixon, F. ASCE, of Johnson, Drake & Piper, Inc., second vice president; Joseph B. Diamond, M. ASCE, treasurer; Eugene F. Moran, Jr., of the Moran Towing Corporation, secretary; and Herbert Giles, of Harold Dessau, Inc., sergeant-at-arms.

New Water Filtration Plant For Suburban Washington

On May 20 the Washington Suburban Sanitary Commission dedicated its Potomac River Water Filtration Plant at Rockville, Md. Located on a 35-acre tract on the Potomac River, 20 miles upstream from Washington, the new $5.5 million plant will supply Montgomery County and surrounding communities as far as Frederick, with filtered and treated water from the Potomac River. It is designed for an initial capacity of 30 mgd, with provision for expansion to at least 120 mgd. The facility is the first stage of a project that will eventually cost $29 million.

Whitman, Requardt & Associates, of Baltimore, Md., were the consulting engineers on the project, and Fischer, Nes, Campbell and Associates, also of Baltimore, the architects. Construction was handled by the Malan Construction Corporation, of Washington, New York, and Chicago.

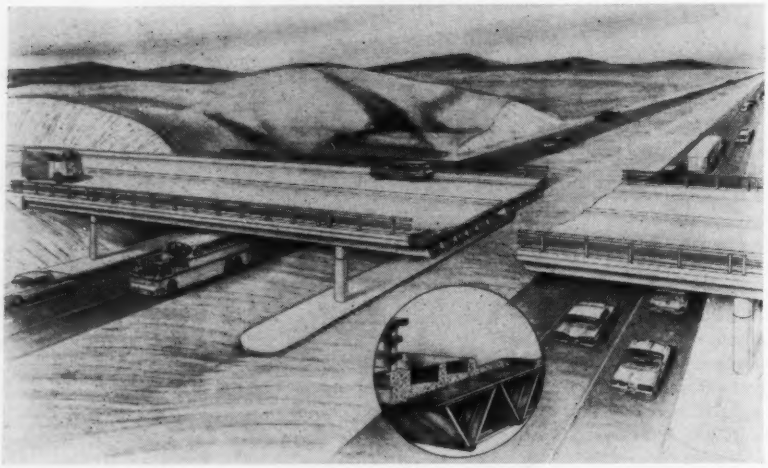
The Sanitary Commission is a public water-sewer agency serving more than 600,000 in Montgomery and Prince George Counties, Maryland. With the new plant, the Commission has facilities for treating 110 mgd.

Bridge Held Best for English Channel Crossing

A highway bridge is held preferable to a railway tunnel as a permanent English Channel crossing. In the opinion of the French Road Union, a bridge is essential to the unhampered flow of road traffic. The organization estimates that a toll bridge would handle about 4.5 million vehicles in its third year of operation and an annual flow of 7 million by 1980. This, the organization thinks, would be enough to make a six-lane structure profitable, even at a projected cost of $640 million. A bridge for both railway and highway traffic, with provision for power, fuel, and communications lines, is urged as most useful and as most economical.

Earlier proposals for a Channel railway tunnel, in which vehicles would be carried on flat cars, is criticized as unlikely to permit uninterrupted flow of traffic.

These views are reported in a recent issue of "World Highways," official publication of the International Road Federation.



Highway Bridge Utilizes Aluminum Components

A completely new type of highway bridge, making use of aluminum cellular components, is being marketed by the Kaiser Aluminum and Chemical Corporation. The first two units will be in service this summer at Amityville, N.Y. Called the Kaiser Aluminum Unistress Bridge, the structure features triangular-shaped components utilizing an aircraft-type, stressed-sheet design. Bolted together edge to edge, the cells form a roadway base of any desired width (see the inset for details). The cost is competitive with conventional steel bridges in spans of 75 ft or more. A prototype of the bridge stood up under a series of tests at Lehigh University.

EXAM GEMS

by Reggie Strashn

R. ROBINSON ROWE, F. ASCE

Last month an academic solution to an academic problem was given with the promise of showing a resourceful solution which helped many who left their math books home and brot their brains along. EXAMGEM 23 read:

A tank containing 100 gal of fresh water has an inflow of brine with 1.0 lb of salt per gal at the rate of 3 gpm, and an outflow of well-diffused mixture at the rate of 2 gpm. How much salt is in the tank after an hour?

Table 1 shows the detailed procedure of one methodical chap, set up like an average-end-area computation of earthwork. He reasoned that the concentration of salt in the tank changed so gradually that the variation could be considered linear for short periods of time, like 10 min. With an outflow of 20 gal in 10 min, the salt loss would be 20 times the mean concentration, or conveniently 10 times the sum of concentrations at beginning and end of the period.

Like which came first, the chicken or the egg, he couldn't determine the concentration at the end of the period until he deducted the salt loss during the period. So he guessed and corrected. Each guess added 30 lb of salt for the known inflow and subtracted 20 times the last-known concentration, these guesses being marked by figures in parentheses. Thus after 30 min he wrote 101.07 (=71.07+30)−10.94 (=20x.547) =90.13, his trial at 40 min. Then 90.13/140=0.644, 10(0.547+0.644)=11.91, and 101.07−11.91=89.16 for his second trial. Similarly for his third trial, which hit it on the nose, the convergence being rapid.

This chap showed all his trials in sequence. Actually he drew a line thru cancelled trials, while others erased them. Reggie recommends against erasure for two reasons: (1) the pattern of convergence checks your arithmetic and may suggest better first guesses for later steps, and (2) if the answer is wrong the examiner can judge the validity of your method.

A word about validity. With a 6-step method, the answer missed the exact method by only ¼ percent, which is usually acceptable. A 3-step method would find x=121.88 for an 0.8 percent error, which might be penalized. Several started 60-step methods, which would have been very precise if any had finished! A good rule is to use very few steps in an exam where time is precious, and use lots and lots of steps in your practice where you just turn it over to the 1620.

Table 1. Average end areas work on brine as well as earthwork, if you cut easy and try hard.

TIME, MIN t	VOLUME, GAL $100+t$ v	SALT, LB x	CONCENTRATION x/v	SALT LOSS 10 TIMES SUM OF END x/v
0	100	0.00	0.000	
				2.73
				2.48
				2.50
10	110	30.00	0.273	
		27.27	0.248	
		27.52	0.250	
		27.50	0.250	
		(57.50		5.00)
				6.87
				6.72
				6.73
20	120	52.50	0.437	
		50.63	0.422	
		50.78	0.423	
		50.77	0.423	
		(80.77		8.46)
				9.79
				9.69
				9.70
30	130	72.31	0.556	
		70.98	0.546	
		71.08	0.547	
		71.07	0.547	
		(101.07		10.94)
				11.91
				11.84
40	140	90.13	0.644	
		89.16	0.637	
		89.23	0.637	
		(119.23		12.74)
				13.47
				13.42
50	150	106.49	0.710	
		105.76	0.705	
		105.81	0.705	
		(135.81		14.10)
				14.66
				14.62
60	160	121.71	0.761	
		121.15	0.757	
		121.19	0.757	

For another application of this kind of exam-room computation a 4-year-old problem has been briefed to its essence in the following.

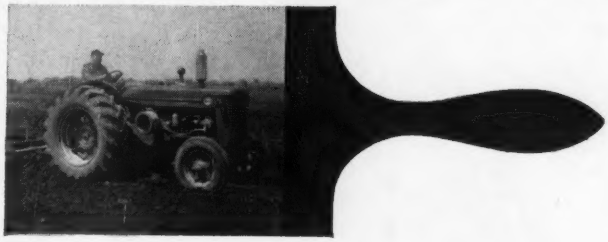
EXAMGEM 24

A lined trapezoidal canal, for which Manning's N=0.016, is 10 ft wide at the bed with side slopes of 1½:1 and designed to flow 5.5 ft deep, on a gradient of 0.0005. Anticipating that total discharge may reach 650 cfs because of intercepted storm water, provision will be made to dispose of the excess over one side of the canal thru a rectangular overflow spillway with an ogee crest at a grade 5 ft above the canal invert. How long must the crest be?

Ground Breaking for Large Cement Plant

Ground-breaking ceremonies for a new $64,000,000 cement plant took place at Ravena, N.Y., on May 19. The new plant, a project of Atlantic Cement Company, Inc., will be one of the largest single installations of its kind ever constructed. The mill has been designed for an initial annual capacity of 10 million barrels, with provision for subsequent increases to 15 and 20 million barrels.

You get LOW TINTING STRENGTH



with

EAGLE-PICHER PERMOX® 1-4-3 (Basic Lead Silico Chromate)

Permox 1-4-3 is not only an outstanding metal protective pigment, it also has very low tinting strength.

This property of low tinting strength makes possible the production of economical, durable and decorative anti-corrosive maintenance paints and enamels in an almost unlimited range of colors. These can vary from deep tones to pastels, without sacrificing rust inhibiting qualities.

Since Permox 1-4-3 is designed to go in all three paint coats, maximum protection against rust becomes *cumulative.* Furthermore, this use of a protective pigment in each coat minimizes the possibility of corrosion arising from skips and holidays during application, and permits the use of an anti-corrosive finish coat for both spot priming and finishing.

Suggested formulations are available for a wide variety of these anti-corrosive and decorative paints designed for specific needs. We welcome inquiries and are prompt to respond.

Permox 1-4-3 Conforms to ASTM Specification D-1648

Since 1843

EAGLE EP PICHER

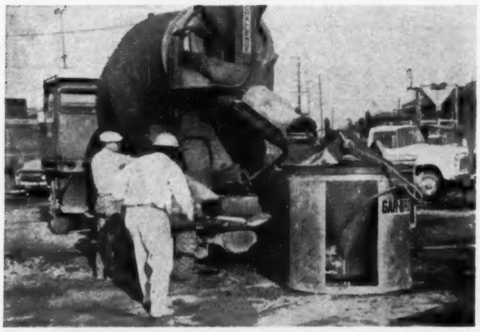
EAGLE-PICHER

The Eagle-Picher Company • Dept. CE-661
Cincinnati 1, Ohio
Regional sales offices: Atlanta, Chicago, Cleveland, Dallas, Kansas City, New York, Philadelphia, Pittsburgh

West Coast Sales Agent, THE BUNKER HILL COMPANY, Chemical Products Division • Seattle • Portland • Oakland • San Francisco • Los Angeles

New! Improved! GAR-BRO CONCRETE BUCKETS

larger gates ... lower loading heights



Designed for stiffer concrete mixes commonly encountered on structural concrete jobs. New Gar-Bro General Purpose Buckets provide fast, thorough discharge...easier loading... positive gate control.

New! Extra large, double clamshell gates and steep side slopes accommodate lower slump concrete mixes. Vertical center discharge eliminates segregation of the mix. Low loading heights (under 60″) for Gar-Bro Buckets of two cubic yard capacity or less permit direct loading from most ready-mix trucks.

Gate control is easy and positive. Gates are non-jamming, grout-tight and self-closing. Buckets are equipped with manual gate control.

Eight bucket sizes range from ⅓ to 4 cubic yards rated capacity. Buckets can be equipped with rubber accordion hoppers or steel sub-hoppers.

Model "D" Buckets

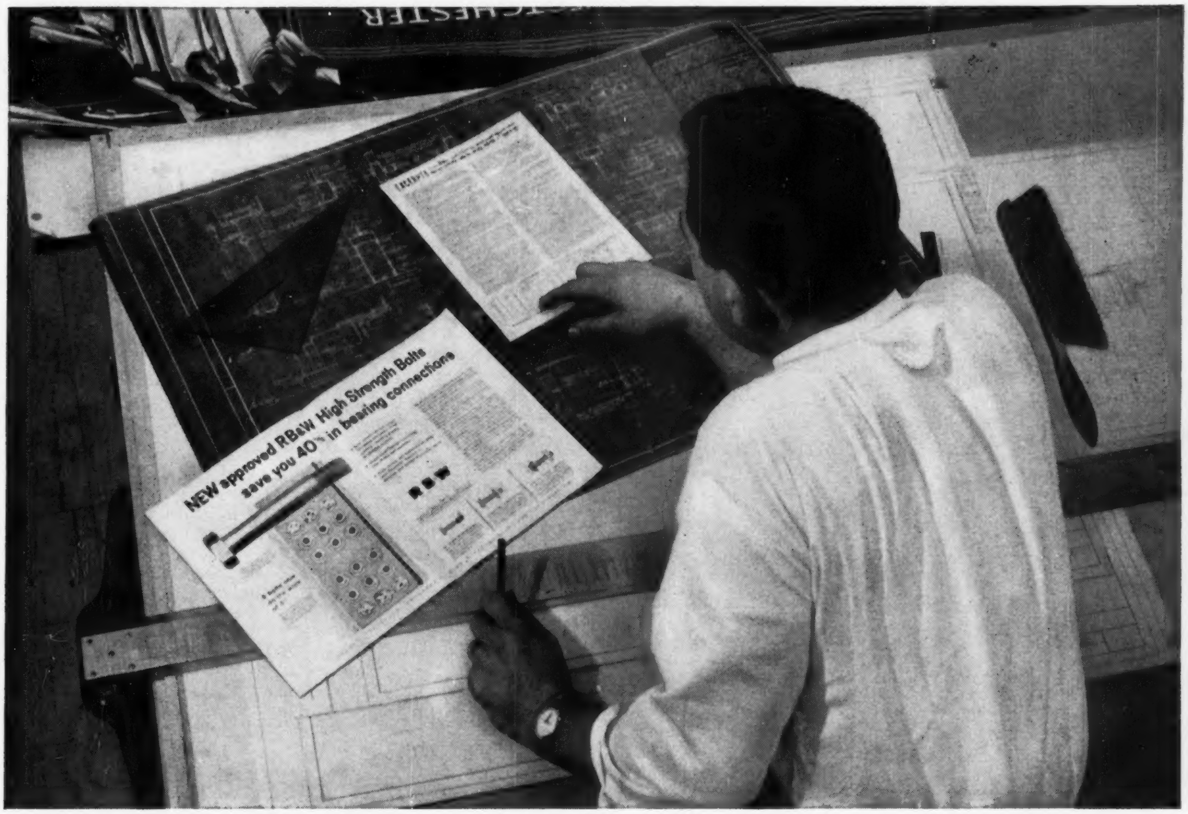
Now in five sizes—1 to 4 cu. yd. rated capacities. Heavy duty, manually operated buckets for dry, low-slump concrete with large aggregate (up to 6″). Meet U.S.E.D. 3 to 1 ratio specifications. Air-operated models available.

See your Gar-Bro dealer today—
or write for complete information.

Gar-Bro Mfg. Co., Los Angeles, California • Peoria, Illinois
General Offices: 2415 E. Washington Blvd., Los Angeles 21, California

GAR-BRO

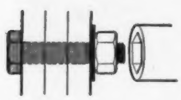
The World's Most Complete Line!
CONCRETE HANDLING EQUIPMENT



Structural engineers see new way to reduce cost of steelwork

An important change in the specification for structural joints permits a designer to work out economies in shop assembly and field erection costs right at his board.

No longer does the specification consider high strength bolts and rivets equal, except in friction-type joints. In the predominant bearing-type joints, the tensile/shear ratio is changed to take advantage of the new large-head short-thread bolts. Two of these do the job of three rivets; or replace three of the regular high strength bolts. Their short thread length excludes shear planes from passing through a threaded section. Thus, the full shank section is available to develop specified shear strength.



Moreover, only *one* hardened washer is used . . . under head or nut, whichever is torqued in tightening. Obviously, by eliminating one-third the holes, one-third the bolts or rivets, and one-half the washers, shop fabricators can save up to 40% on connections. Field erectors can realize savings similar to these.

But these savings won't be completely realized, and reflected in lower costs, until *the designer puts this new fastening improvement to work.*

So, if you're a structural engineer, plan now on the economies in the new RB&W High Strength Bolt. And if you're a fabricator or field erector, count on a full size range of these bolts from RB&W . . . all with traditional RB&W quality and certified conformance to ASTM A325 specification. For more data, write Russell, Burdsall & Ward Bolt and Nut Company, Port Chester, N. Y.

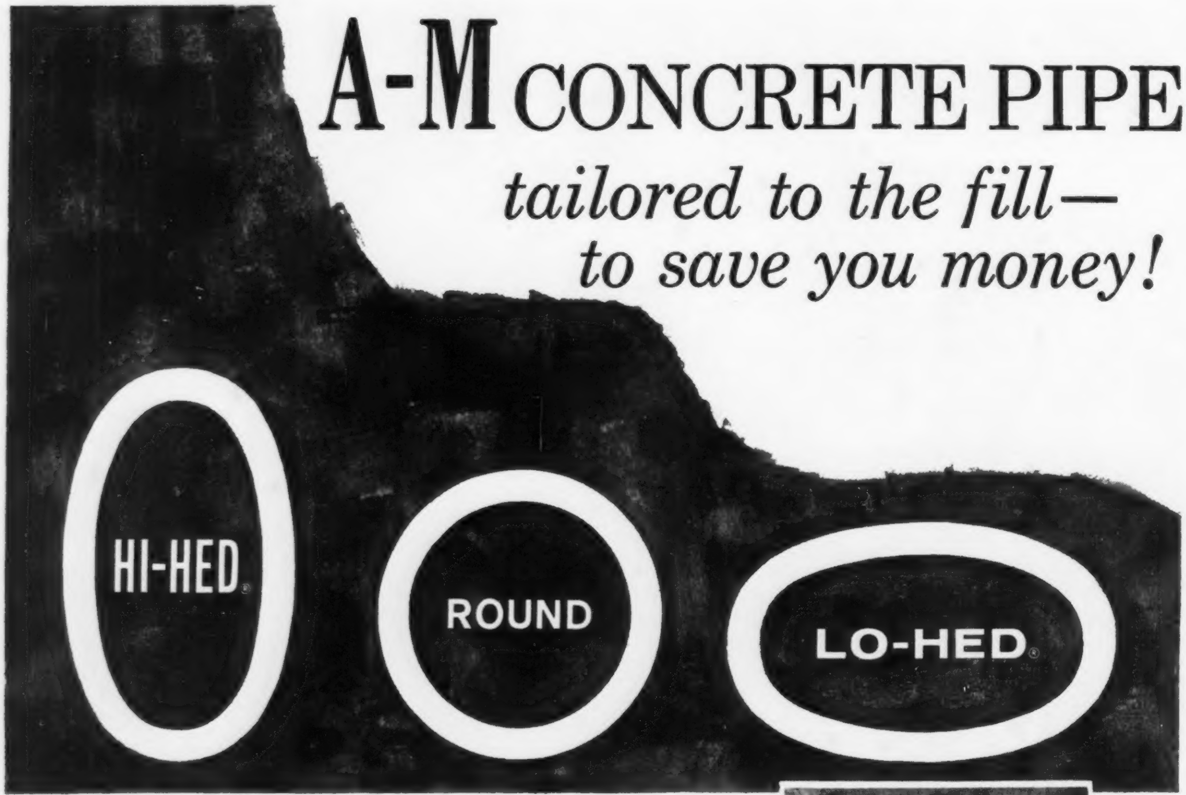
RB&W
116th year

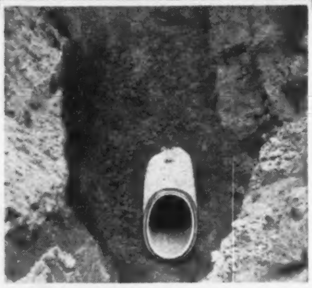
Plants at: Port Chester, N. Y.; Coraopolis, Pa.; Rock Falls, Ill.; Los Angeles, Calif. Sales office and warehouse at: San Francisco, Calif. Sales offices at: Ardmore (Phila.), Pa.; Pittsburgh; Detroit; Chicago; Dallas. Sales agents at: Cleveland; Milwaukee; New Orleans; Denver; Fargo.

LARGEST INDEPENDENT PRODUCER OF HIGH STRENGTH BOLTS FOR CONSTRUCTION

A-M CONCRETE PIPE

tailored to the fill— to save you money!





FOR HIGHEST FILLS AND HEAVY LOADS, Hi-Hed® is the *most economical* permanent sewer and culvert pipe because it is designed for minimum vertical load and maximum lateral support.

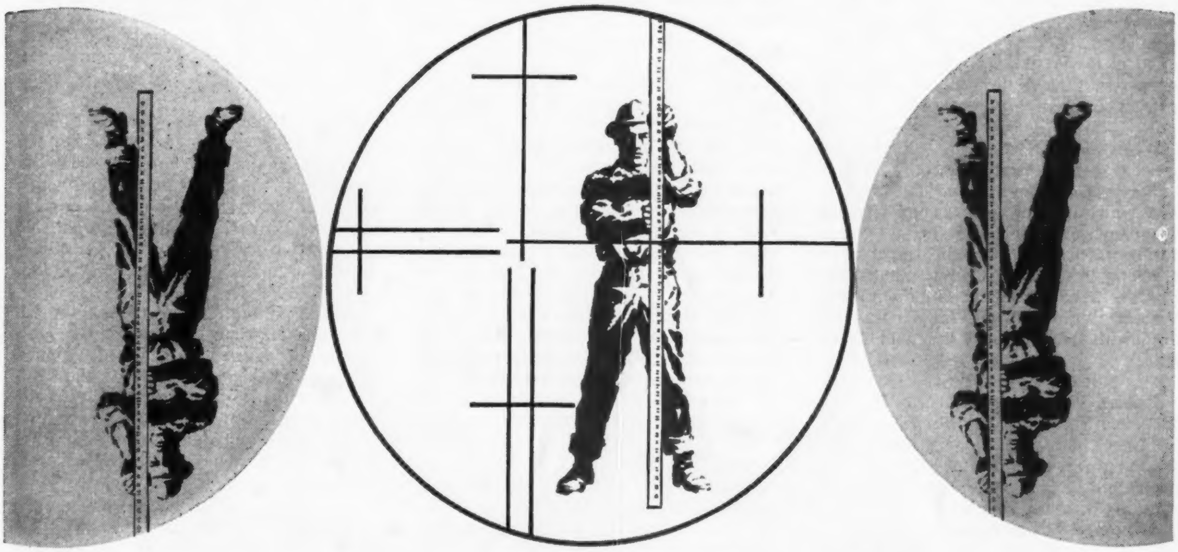
FOR AVERAGE FILLS, round concrete pipe is the *most economical* permanent conduit and American-Marietta saves added dollars through nationwide technical and manufacturing services.

FOR LOW FILLS, Lo-Hed® is the *most economical* permanent pipe because it offers maximum capacity under minimum cover and has inherent strength for greater resistance to impact.

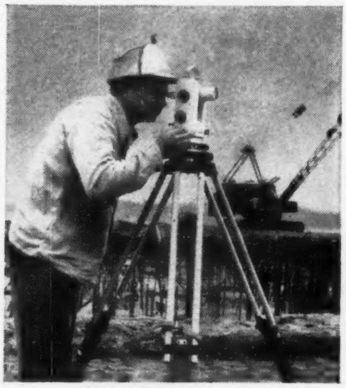
AMERICAN-MARIETTA COMPANY
CONCRETE PRODUCTS DIVISION
GENERAL OFFICES:
AMERICAN-MARIETTA BUILDING
101 EAST ONTARIO STREET, CHICAGO 11, ILLINOIS, PHONE: WHITEHALL 4-5600

with a

K+E THEODOLITE



you can see it right side up!



That's right – every "e" model in the exciting new line of K&E Theodolites features an *erected image**... and they're the *only* theodolites that *do!* With a K&E "e" model Theodolite, there's never any need for special equipment or expensive accessories as required with inverted image models. You use your *regular* rods, targets, stakes, etc.– and you see everything *right side up!*

Another important feature–all K&E Theodolites "double in brass," doing the work of both *transit* and *level.*

Specifically engineered to conform to *American* surveying practice, and built to K&E specifications by world-famous *Askania-Werke* of Germany, these brilliant new K&E Theodolites offer many other major refinements engineers have long requested. See the complete line soon – at your local K&E Dealer's – or fill out and mail the coupon below for further information.

**Inverted image available on all models if preferred.*

K+E

KEUFFEL & ESSER CO.

NEW YORK • HOBOKEN, N. J. • PHILADELPHIA • DETROIT
CHICAGO • MILWAUKEE • ST. LOUIS • DALLAS • DENVER
SAN FRANCISCO • LOS ANGELES • SEATTLE • MONTREAL

KEUFFEL & ESSER CO., Dept. CE-6, Hoboken, N.J.

Gentlemen:

Please send me further information on the complete line of K&E Theodolites.

Name & Title________________

Company & Address________________

________________ 3085

DECEASED

Ramon J. Benvenuti (J.M. '56; A.M. '59), age 26, since graduating from Norwich University five years ago with a B.S. in civil engineering, had been employed in the bridge department of the Vermont State Highway Department as a civil engineer. He also served briefly in 1958 with the Army Corps of Engineers at Fort Campbell, Ky., as a 2nd Lieutenant.

Loren Clark Bishop (M. '43; F. '59), age 75, well known throughout the West for his work on interstate water compacts, from 1907 to 1939 engaged in private practice in Wyoming, followed by 18 years—until his retirement in 1957—as state engineer of Wyoming.

Wesley P. Bliffert (A.M. '40; M. '59), age 53, before establishing the Bliffert Concrete Company in the late 1940's, was with the Tews Lime and Cement Company, of Milwaukee, for 17 years during which time he was instrumental in developing their first concrete plants. Mr. Bliffert, who saw active duty with the Seabees during World War II, was retired with the rank of Lieutenant Commander.

Robert Platt Boyd (M. '20; F. '59), age 76, a founder of the American Association of State Highway Officials, was a pioneer in the Alabama Highway Department, serving as the first assistant state highway engineer when the Department was organized 50 years ago. At the time of his retirement in 1956, he was employed in the Atlanta, Ga., office of the U.S. Bureau of Public Roads.

Kenneth Brunner (A.M. '53; M. '59), age 37, who graduated from the Technological Institute at Northwestern University in 1948, started his career as a junior civil engineer with the California Division of Highways that same year. He was subsequently appointed assistant highway engineer and associate highway engineer. Thereafter, he was engaged by Francis H. Bulot, of California.

Harry Lester Conrad (M. '47, F. '59), age 71, continuously in the general construction field since 1906, at the time of his recent death was completing 28 years as president of the Christman Company, of Lansing, Mich. He was first employed by the firm in 1910 as an estimator, becoming successively engineer, project manager and president.

Joseph L. Dermody (A.M. '46; M. '59), age 45, for the past three years was assistant public health engineer for the Yonkers (N.Y.) City Health Bureau. During an earlier 13-year period Mr. Dermody had been a sanitation engineer with the U.S. Public Health Service.

Lester Campbell Draughon, Jr. (J.M. '56; M. '59), age 26, an ensign in the Public Works Department of the U.S. Navy Civil Engineer Corps at the New Orleans, La., naval station, was graduated from North Carolina State College with a bachelor in civil engineering in 1956. For a brief time he was an engineer-in-training with the Army Corps of Engineers in Wilmington, N.C.

Arthur M. Dunlap (A.M. '49; M. '59), age 61, in recent years had been in charge of the Benham Engineering Company field force in his capacity as field engineer with the Oklahoma City firm.

Albert Givan (M. '28; F. '59), age 84, the first chief engineer and general manager of the Sacramento (Calif.) Municipal Utility District, had been in retirement for the past several years. During those early years his "big contribution was the complete exploration of the then underdeveloped resources of the South Fork of the American River," which has since become the Silver Creek Project. Known as the father of the Engineering Registration Act of California, he was also city engineer of Sacramento on two occasions, from 1912 to 1915 and again from 1921 to 1923. The first president of the Sacramento Section, Mr. Givan for 25 years served it as legislative chairman.

John G. Gruss (M. '48; F. '59), age 67, former principal engineer, vice president and secretary of Albright & Friel, Inc., of Philadelphia, Pa., over a 40-year period had charge of the design of major hydraulics, bridges and suburban planning projects for the firm. Outstanding among them was the $35-million cleanup of the Schuylkill River and the direction of engineering work on the Aberdeen Proving Ground in Maryland and the Army Air Base at New Castle, Del.

Luther E. Gregory (M. '04; F. '59), age 88, for most of the years since retiring as a Rear Admiral in charge of the Navy's Bureau of Yards & Docks in 1930, had maintained a consulting practice in Seattle, Wash. Before establishing his practice, however, he served in the early 1930's as director of exhibits at the Chicago World's Fair.

William Wright Harts (M. '98; F. '59), age 94, Brigadier General (retired), U.S. Army, while military aide to President Woodrow Wilson prior to World War I supervised the construction of the Lincoln Memorial, the Arlington Memorial and the Red Cross Building in the national capital. After serving in Europe during the war as Commander of the Sixth Engineers Regiment, General Harts from 1919 through 1920 was chief of staff of the Army Occupation and from 1922 through 1923 was its Commanding General. His many awards included the Society's Rowland Prize.

John J. Hedrick, Jr. (M. '54; F. '59), age 71, ten years ago established John J. Hedrick, Jr. & Associates in Tampa, Fla. Starting in 1912 he had served Tampa as assistant city engineer, followed in 1919 by appointment as county engineer of Hillsborough County with offices in Tampa. Thereafter, he was with the U.S. Department of Interior for ten years.

William Frederick Hunter (M. '41; F. '59), age 63, only a year ago retired from the New Jersey State Highway Department where he was assistant director and chief bridge engineer. He was a graduate of the University of North Carolina and a former Commander in the Civil Engineer Corps of the U.S. Navy.

Robert Hyde Jacobs (M. '19; F. '59), age 89, who retired in 1934, was for many years a civil engineer with the New York Aqueduct Commission, which he left to become division engineer with the New York City Subway System. He graduated from the Cornell University College of Civil Engineering in 1893.

Arthur Ripont Keller (A.M. '11; M. '59), age 78, dean emeritus of the University of Hawaii College of Applied Science and vice president of the University when he retired in 1947, was the guiding spirit of engineering education development in Hawaii. After his retirement Dean Keller continued to serve the University in a consulting capacity.

Gerard R. Kenly (A.M. '60), age 29, resident engineer at the Newell Dam site near Ben Lomond, Calif., for Creegan and D'Angelo, of San Jose, in the past decade of service with the firm, was designer of the San Felipe and Hernandez Dams in California. In 1959 he developed a theory for programming the "Swedish Slip Circle" method of slope stabilization for an LGP 30 Electronic Computer.

Heathcote William Lawson (M. '40; F. '59), age 71, assistant chief engineer at Schacht Steel Construction, Inc., in Hillside, N.J., had been structural designer in the 1920's for New York City's theatre showplace, the Roxy. After two years as section manager on the Brookhaven Nuclear Reactor project for the H. K. Ferguson Company, Mr. Lawson in 1949 opened a consulting structural engineering practice in Englewood, N.J.

Stephen Negrey (M. '33; F. '59), age 66, most recently was consulting engineer with the Newark, N.J., firm of Neil J. Convery, and before that had been a construction engineer in the New York and New Jersey offices of F. G. Necker.

W. W. Tennant (A.M. '35; M. '59), age 73, former head of the coordination division of the Esso Standard Oil Company, had retired several years ago. One of the original members of the greater Baton Rouge (La.) Port Commission

(Continued on page 120)

which he helped found, Mr. Tennant had been with Esso since 1910.

Russell H. Trites (M. '50; F. '59), age 57, was most recently civil engineer with the Defense Department in Washington, D.C. On a previous occasion he had served with the Army Corps of Engineers in the office of the chief of engineers.

John Ralph Van Duyne (M. '14; F. '59), age 82, who retired in 1958 as chief engineer of the Passaic Valley Sewerage Commission at Newark, N.J., as early as 1912 had been a division engineer with the Commission. In the first decade of the 1900's he had served as resident engineer for the City of Newark and as engineer with the New York City Board of Water Supply.

Victor A. Vollmer (M. '47; F. '59), age 65, after seven years as structural engineer and then assistant chief engineer for Ellis Wing Taylor, of Los Angeles, in recent years had been district structural engineer with the California Division of Architects at Los Angeles. This experience was preceded in the 1930's by his work as chief structural engineer on the design of industrial buildings and Federal Housing projects while in the employ of Fletcher-Thompson, Inc., of Bridgeport, Conn., and by his work on the upper Mississippi River Canalization Project as associate structural engineer with the Army Corps of Engineers.

Francis J. Von Zuben (A.M. '19; M. '59), age 78, had been employed in various capacities by the City of Fort Worth, Texas, continuously since 1905 when he worked as resident engineer on a sanitary sewer and disposal plant project. Subsequently, he was assistant city engineer, city engineer and city planner, and recently consulting and supervising engineer.

Watson Vrendenburgh (M. '10;F. '59), age 85, as a member and later as president of Hildreth & Company, Inc., New York City, did extensive design work on highways and city bridges in several states before the establishment of highway commissions; renovated the entire bridge system of the Brazilian railways; and for a seven-year period purchased all materials for the construction of the Alaskan railroad.

Robert W. Wallace (M. '30; F. '59), age 72, planning engineer for Chicago's subways and highways, had had long and varied experience in municipal engineering. As a former concrete pavement engineer with the Universal Portland Cement Company in Chicago, he served as a consultant to city and village engineers in his specialty. This was followed by the positions of secretary, treasurer and general manager with the municipal engineering firm of Barker, Flavin, Sheets and Wallace, Inc., and by appointment as chief field engineer for the Portland Cement Association.

John Hough Wickersham (M. '13; F. '59), age 78, for more than half a century was president of John A. Wickersham Engineering and Construction, Inc., of Lancaster, Pa. Mr. Wickersham received his civil engineering degree and his doctorate from the Sheffield Scientific School at Yale University.

George J. Willier (M. '39; F. '59), age 54, for the past 15 years was branch manager and sales engineer for the Foxboro Company in Kansas City, Mo. This had been preceded by several years of valuation studies for the Missouri Public Service Commission.

Harry K. Wilson (A.M. '19; M. '59), age 78, since 1958 had been an associate in Charles H. Sells, Inc., of New York. Graduated from Cornell University, class of 1908, he subsequently worked for the Lackawanna Railroad and the New York consulting firms of B. H. Davis and A. B. Cohen.

Kenneth Eugene Wyatt (A.M. '58; M. '59), age 34, in the past six years had been promoted from assistant to the design squad leader in the California Division of Highways to assistant highway engineer of the Division at San Luis Obispo. Since graduating with a BS in civil engineering from Iowa State College ten years ago, Mr. Wyatt had, also, served for two years, 1952 to 1954, as field engineer with the Shappert Engineering and Construction Company.

Seal Coating with Cationic Bitumuls produced uniformly fine results in spite of early showers

CATIONIC BITUMULS SPEEDS SEAL COATING IN TACOMA

The City of Tacoma, Washington, has two major sources of street maintenance problems. First, some forty miles of very old (1890-1915) sheet asphalt surfaces. These are now badly cracked and extensively patched. Second, several hundred miles of streets that have only a light bituminous treatment. The ever-increasing traffic load is starting to cause trouble on these.

In the past, the City has settled for continuous patching on the sheet asphalt; and Seal Coating of the light bituminous arterials, using either anionic emulsions or cutbacks. The Seal Coating required closing the streets to traffic for long periods; and weather was a constant threat, restricting the work seasonally.

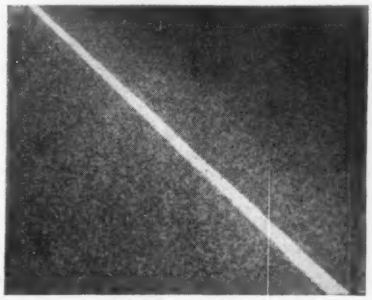
City maintenance forces were quick to see two major advantages of Cationic Bitumuls when it was first introduced. A—This material had a natural affinity for the cover aggregate being used. B—The rapid-setting characteristics sharply reduced the danger of "wash-off" from rain. (When showers actually occurred within two hours of job completion, there was no damage!)

Based on earlier work the City was able to "field" a well-integrated Seal Coating team. Cationic Bitumuls sets rapidly so that Seal Coating operations were co-ordinated even more closely. Both the cover-stone truck and the pneumatic roller could follow very closely behind the distributor!

The Seal Coating operation has now been extended to the "ancient" sheet asphalt pavements. Here it prevents the break-up action that made earlier patching necessary.

Using Cationic Bitumuls, streets are closed to traffic a much shorter time; and the work season begins much earlier in the year.

Discover for yourself the ability of Cationic Bitumuls to extend the work season; and to coat and hold most aggregates—even those normally regarded as "difficult". Bitumuls Engineers in our nearest office will supply full information; and will arrange for you to see a Cationic Bitumuls job in your area.



Close-up view of a Cationic Bitumuls Seal Coat. Note uniform cover-stone retention

American Bitumuls & Asphalt Company

320 MARKET ST., SAN FRANCISCO 20, CALIF.
Perth Amboy, N. J.
Baltimore 3, Md.
Cincinnati 38, Ohio
Atlanta 8, Ga.
Mobile, Ala.
St. Louis 17, Mo.
Tucson, Ariz.
Portland 8, Ore.
Oakland 1, Calif.
Inglewood, Calif.
San Juan 23, P. R.

BITUMULS® Emulsified Asphalts • CHEVRON® Paving Asphalts • LAYKOLD® Asphalt Specialties • PETROLASTIC® Industrial Asphalts

New Publications

Highway research . . . . Issuance of a new publication reporting research findings in the highway field is announced by the Highway Research Board. The new bulletin—entitled "Road Roughness and Skidding Measurements: 1960" and identified as Bulletin 264—is available from the Highway Research Board, 2101 Constitution Avenue, N. W., Washington, D. C. The price is $1.00.

Air pollution . . . . State and local agencies working in the field of air pollution control are listed in a joint publication of the Air Pollution Control Association and the U. S. Public Health Service. For the first time Canadian control agencies are included. Inquiries about the reference—entitled "Directory of Governmental Agencies as of December 1, 1960"—should be addressed to the Editor, Directory of Governmental Air Pollution Agencies, Air Pollution Control Association, 4400 Fifth Avenue, Pittsburgh 13, Pa.

Concrete, finishing . . . A compilation of methods of finishing formed concrete surfaces that eliminate surface blemishes has been prepared by the Corps of Engineers' Waterways Experiment Station. Methods investigated are those of the American Concrete Institute, the Portland Cement Association, and the Bureau of Reclamation. Copies of the reference, identified as Technical Report No. 6-559, may be obtained from the Director, U. S. Waterways Experiment Station, Vicksburg, Miss., at 50 cents each.

Paints and coatings . . . . Results of the Building Research Institute's second conference on paints and coatings, held in the spring of 1960, have been issued as Publication 796 of the National Academy of Sciences—National Research Council. The emphasis of the fruitful second conference was on field surface preparation, field application methods, and water-thinned materials. The publication, priced at $5.00, is available from the Building Research Institute, 2101 Constitution Avenue, N. W., Washington 25, D. C.

Loess soils . . . . Issuance of a new Bureau of Reclamation engineering monograph, "Petrographic and Engineering Properties of Loess," by H. J. Gibbs, M. ASCE, and W. Y. Holland, is announced. In addition to summarizing knowledge of the physical and physical-chemical properties of loess—a wind-deposited earth material that covers vast areas of the West—the new monograph also gives data on the results of loading tests of footings and piles in loessial soils. Copies, priced at $1.00 each, may be obtained from the Office of the Assistant Commissioner and Chief Engineer (attention Code 841), Bureau of Reclamation, Building 53, Denver 25, Colo.

Research . . . . The Bureau of Standards' vigorous research and measurement program in fiscal 1960 is reported in "Research Highlights of the National Bureau of Standards." Some 225 programs in eighteen different fields of research and development are described. Copies are for sale by the Superintendent of Documents, GPO, Washington 25, D. C., at 65 cents.

Cement standards . . . . Availability of the 1960 edition of the "Compilation of ASTM Standards on Cement" is announced by the American Society for Testing Materials. The ready reference includes eight specifications, 26 methods of test, and several definitions. Copies, at $4.00 each, may be ordered from ASTM headquarters, 1916 Race Street, Philadelphia 3, Pa.

Construction safety . . . . Safe building practices—one of many aspects of safety discussed at the 1960 National Safety Congress—are the subject of "Construction Industry: Public Employee," one of a series of twenty-five volumes comprising the Transactions of the 1960 Congress. Identified as Vol. 8, the publication sells for 65 cents (less in bulk orders) and may be obtained from the National Safety Council, 425 North Michigan Ave., Chicago 11, Ill.

RECENT BOOKS

(added to the Engineering Societies Library)

ASTM Standards on Cement
Fifteenth Edition

Standards and tentative specifications, methods of chemical analysis, and methods of physical testing pertaining to cement are presented. Methods added since the previous edition cover false set of Portland cement, fineness of hydraulic cement by No. 325 sieve, and potential sulfate resistance of Portland cement. Changes and additions have also been made in the appended Manual of Cement Testing and Selected References on Portland Cement. (Published by the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., 1960. 288 pp., bound. $4.00.)

Bibliographic Survey of Corrosion, 1956

This is the seventh in a series which covers corrosion literature for the period 1945-56 inclusive. This volume includes abstracts of almost all of the articles published during 1956 that have come to the attention of the association, and also 58 abstracts of articles published in prior years which have come to the attention of NACE since publication of the 1954-55 Bibliographic Survey. (Published as Publication 60-12 by the National Association of Corrosion Engineers, 1061 M & M Building, Houston 2, Texas, 1960. 240 pp., paper.)

Engineering Drawing and Geometry
Second Edition

A fundamental text that deals with basic drawing, descriptive geometry necessary for solution of problems in design and drafting, various types of graphical computations, and various specialized applications of engineering drawing. In this edition five new chapters have been added on material specifications, nomography, graphical vector analysis, curve fitting, and graphical mathematics. The chapters on dimensioning have been rewritten so as to conform to the latest American standards. (By Randolph P. Hoelscher and Clifford H. Springer. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y., 1961. bound. $8.95.)

Engineering Economics and Practice

This is the 1961 edition of a useful compilation which briefly surveys the subject content of the New York State Professional Engineer examinations, Part III—Professional Engineering. Topics covered include compound interest formulas, depreciation, comparison of alternate proposals, calculating a prospective rate of return, replacements, and costs. Problems and answers for exams in this section held from July 1957 through June 1960 are given. Also included are interest tables of $(1 + i)^n$ and illustrations of their use. (By Max J. Steinberg and William Glendinning. Published by the author, Mr. William Glendinning, 5123 Bell Boulevard, Bayside 64, N. Y., 1961. 106 pp., paper. $3.25.)

Economics of Watershed Planning

This volume contains the twenty-one papers and accompanying discussions which constitute the Proceedings of the Symposium on the Economics of Watershed Planning held at Knoxville, Tennessee in June 1959, and sponsored by the Southeast Land Tenure Research Committee, the Farm Foundation, and TVA. The aim of the Symposium was to examine the complex problems of small watershed development. The aim of the book is to contribute to a variety of working-level planning decisions that concern engineers, administrators and legislators in current water resources development but it also is concerned with how small watershed development can best fit into river basin and regional planning. (Edited by G. S. Tolley and F. E. Riggs. The Iowa State University Press, Ames, Iowa, 1961. 339 pp., bound. $3.95.)

Farm Building Design

The functional and analytical design of farm buildings, including farm houses, barns, sheds, shades, storages, grain bins, silos, animal shelters. water supply facilities, and septic tanks is presented. The first part of the book deals with structural types and functions and describes the basic requirements, technical design, and construction methods involved in building structures on the farm. The second part covers materials and structural design and discusses the proper use, efficient design, loadings, and costs of construction materials. (By Loren W. Neubauer and Harry B. Walker. Prentice-Hall, Inc., Englewood Cliffs, N. J., 1961. 611 pp., bound. $8.50.)

First International Conference on Waste Disposal in the Marine Environment, Proceedings

The 27 papers presented at the Conference, held at the University of California, Berkeley in July 1959, are arranged in topical sections dealing with public health (public bathing facilities); effects of wastes on marine biota and the use of marine invertebrates as indicators of water quality; design considerations (discharge of wastes into the sea, river and ocean confluence, ocean currents, etc.); nearshore oceanography and waste disposal; receiving water analysis; and estuarine hydrography in relation

(Continued on page 128)

1961 ASCE Hydraulics Division Conference, Aug. 16-18

Advance Reservation Request

Please mail by July 8 to: J. M. ROBERTSON
ASCE HYDRAULICS CONFERENCE, 125 Talbot Lab.
University of Illinois, Urbana, Ill.

Name ....Company........................

Address ....

Accompanied by: wife ☐, boys..........., girls..........., others.............
(indicate ages, please)

Arrival date and time: ...., via: ...., departure: ....

Housing request:

Dormitory Reservation ☐ Hotel and Motel Information ☐ (check one)

Number planning to attend special events:

Luncheon (16th)	@ $1.50 ☐	Lincoln Tour (on 18th)	@ $5.00 ☐
Allerton, Adults	@ $1.75 ☐	Water S. & Drain. Tour (19th)	@ $2.00 ☐
Children	@ $1.00 ☐	Young Peoples Events (swim, etc.) on 16th ☐, on 17th ☐	
Banquet (17th)	@ $3.50 ☐		

One of Southern California's largest home developments, Eastgate, assures low-cost, efficient water service for its 2250 homeowners with "K&M" Asbestos-Cement Pressure Pipe.

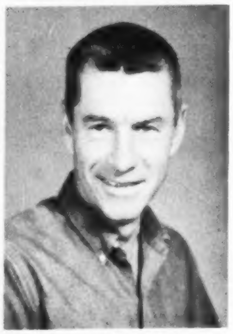
22 MILES OF "K&M" ASBESTOS-CEMENT PRESSURE PIPE ASSURE

dependable water service for a spanking new city of 10,000!

Modern cities like Eastgate spring full-grown from the earth—complete with homes, schools, shopping center and even a hospital. To make such a city a reality calls for modern methods and modern materials, such as "K&M" Asbestos-Cement Pressure Pipe. This rugged pipe was the builder's choice for its freedom from maintenance and for its durability. He knows today's particular home buyers demand materials that function without failure for years and years. Another important factor was the ease of installation and handling "K&M" Asbestos-Cement Pressure Pipe offers. Robert Kennedy, of Kennedy Pipe & Supply Company, tells you, in his own words, how "K&M" Asbestos-Cement Pressure Pipe helped him adhere to a tight schedule.

"THE 'K&M' FLUID-TITE® COUPLING HELPED US LAY MORE PIPE PER HOUR!"

"We had no trouble keeping up with the builder's tight schedule with 'K&M' Asbestos-Cement Pressure Pipe and the 'K&M' FLUID-TITE Coupling. All we had to do was lubricate the pipe end, and slide it into the coupling. This gave us a joint tight under all operating conditions. We didn't need any heavy machinery or coupling pullers. 'K&M' Pipe was lightweight and easy to handle, which permitted us to work smoothly. It reduced our installation time and costs considerably."



Robert Kennedy, President, Kennedy Pipe & Supply Company, Paramount, Calif.

After it's in the ground, "K&M" Asbestos-Cement Pressure Pipe is practically indestructible. It won't tuberculate. This assures the taxpayer of the same water flow and pressure years later, that he had when his home was new. Pumping costs remain low. Joints stay watertight. In addition, this pipe resists corrosion, and is immune to electrolysis.

For more information write to: Keasbey & Mattison Co., Ambler, Pa.

K·M BEST IN ASBESTOS Keasbey & Mattison at Ambler

The light weight of "K&M"® Asbestos-Cement Pressure Pipe permits you to lay most sizes by hand . . . and reduces shipping costs.

Assembling the exclusive, patented "K&M" FLUID-TITE® Coupling and Pipe takes but an instant.

Recent Books

(Continued from page 124)

to waste disposal. (Edited by E. A. Pearson, Pergamon Press, Inc., 122 East 55th Street, New York 22, N. Y., 1960. 569 pp., bound. $10.00.)

Foundations and Soil Properties

The subtitle describes this book as a "practical guide to the methods of improving the physical properties of ground to increase its strength". A British civil and railway engineer, the author first describes the nature of soil formation and the testing of soil properties both on site and in the laboratory, followed by a discussion of various actual soil formations, methods of overcoming undesirable tendencies, the strengthening of needed qualities, and selection of the best processes for this purpose. In giving illustrations of the discussion, the author describes "in reasonable detail" many construction projects of particular interest throughout the world. (By Rolt Hammond, Macdonald and Company (Publishers) Ltd., London, England, 1961. 181 pp., bound. 30s.)

Library Services

Engineering Societies Library books, except bibliographies, handbooks, and other reference publications, may be borrowed by mail by ASCE members for a small handling charge. The library also prepares bibliographies, maintains search and translation services, and can supply a photoprint or a microfilm copy of any items in its collection. Address inquiries to R. H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N. Y.

Hydrodynamics
Second Edition

The overall organization of this edition closely follows that of the 1950 edition. The material, carefully revised in detail and including new developments in the past decade, was presented in a graduate course at Harvard University. Two special aspects of fluid dynamics are emphasized: the complicated logical relation between theory and experiment, and application of symmetry concepts. The relation between theory and practice, introduced in the first two chapters by cases wherein plausible reasoning has led to incorrect results, is closely studied in Chapter 3 in the special cases of flows with free boundaries, and further illuminated by an analysis and justification of modeling in Chapter 4. This chapter also introduces the second aspect dealt with, in describing the origins of modeling in symmetry concepts. Applications of these concepts are considered in the final two chapters, in solutions of problems involving compressible and viscous flows, and in developing the classical theory of virtual mass as a special case of the theory of homogeneous spaces. (By Garrett Birkhoff. Princeton University Press, Princeton, N. J., 1960. 184 pp., bound. $6.50.)

Hydrometry

The author of the 1960 Polish original of this translation, a professor of hydraulics at the Technical University, Wroclaw, Poland, examines the theory and practice of hydraulic measurements as they are applied in "hydrotechnics and water-supply engineering". Section one discusses the principles and methods of measurements of time, angle, linear quantities, surface, volume, pressure, velocity, intensity of flow and total flow. Section 2 describes the instruments and apparatus used to measure these same hydromechanical quantities. Measurements of the physical quantities which determine the properties of a liquid are not discussed. The final section is a brief account of hydrometric laboratories—their classification, equipment, design principles, and supply installations such as overhead reservoirs, conduits, water meters and accessories. (By Adam T. Troskolanski. Pergamon Press, Inc., 122 East 55th Street, New York 22, N. Y., 1960. 684 pp., bound. $18.00.)

(Continued on page 130)

Recent Books

(Continued from page 128)

Liberal Education and Engineering

This monograph is the ninth in a series reporting studies made by the Institute of Higher Education of Teachers College, Columbia University, of undergraduate professional curricula. It deals with the issues and practices in engineering education related to the overriding problem facing American higher education today: how to provide both the specialized education required for technological progress, and the general education essential to ideological strength. The monograph then reviews practices as revealed in the literature and in visits to a number of engineering schools. The concluding chapters summarize contemporary issues and present certain suggestions for their resolution. (By Edwin J. Holstein and Earl J. McGrath, Bureau of Publications, Teachers College, Columbia University, N. Y., 1960. 132 pp., paper. $2.75.)

Manual on Industrial Water and Industrial Waste Water

Second Edition

This manual consists of two parts. The first discusses the general uses and problems of sampling and analyzing of industrial water, while the second includes the ASTM standards on industrial water and waste water. This edition differs from the first in that it takes cognizance of the increased interest in the potential effects of certain waste waters on downstream uses. (Published as ASTM Special Technical Publication No. 148-E by the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., 1960. 658 pp., bound. $11.00.)

Mathematical Handbook for Scientists and Engineers

This is a comprehensive reference collection of mathematical definitions, theorems, and formulas for scientists, engineers and students, including both undergraduate and graduate level material. Proofs are omitted, and related formulas are presented in concise tables, enabling compact treatment and a special arrangement of topics. This special arrangement, within each chapter, is such that a terse, connected review of each subject is accomplished. Numerous references also are given to provide access to other material for more detailed studies. Six appendices contain numerical tables, tables of integrals and Fourier expansions and other such useful data. (By Gramino A. Korn and Theresa M. Korn. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 1961. 943 pp., bound. $20.00.)

Measurements for Engineering

Written primarily as an undergraduate textbook, this book presents a comprehensive theoretical approach to engineering measurements, and field instructions in the use of surveying instruments and equipment. The later chapters deal also with practical applications of surveying measurements, especially those that are used on engineering projects. The book covers topics from both introductory and second semester courses. Also included are a new method for the adjustment of traverses and some new equations for solution of survey problems, both appearing here for the first time in print. (By Michael V. Smirnoff. Prentice-Hall, Inc., Englewood Cliffs, N. J., 1961. 556 pp., bound. $9.75.)

Nondestructive Testing

Group Leader for Nondestructive Testing at the Argonne National Laboratory, the author has prepared a textbook for the beginning student and technician in this field. The emphasis throughout is on physical principles, and the full scope of nondestructive testing—for the measurement of the physical properties or nonconformity in physical properties of materials, as well as for the detection and location of flaws. Separate chapters describe visual, pressure and leak, thermal, dynamic, magnetic, and electrical methods of testing; liquid penetration inspection, X-ray radiography, gamma radiography, ultrasonics, and thickness measurements. One chapter is a brief review of other useful techniques, such as spot tests, sulfur printing, activation analysis, and the resistance strain gage. (By Warren J. McGonnagle. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 1961. 455 pp., bound. $15.00.)

Plastics as Building Construction Materials

This report was prepared by a group of second year students at Harvard Graduate School of Business Administration as a requirement in a manufacturing course. Their eight-month project was developed in three phases, beginning with a study of the general field of plastics which was narrowed down to a concentration on those plastics appearing to offer the best potential uses in the building construction field. The second phase consisted in accumulating information from literature, and from those active in the plastics field, in universities, government organizations, and industry. The third phase involved identification of problem areas in the use of plastics as building construction materials, and selection and analysis in detail of those problems deemed most important. Although the selecting was done by non-experts, the recommendations and conclusions given are interesting reflecting as they do current attempts at solutions, as well as the authors' own progressive ideas. (Published by the Structural Plastics Associates, P.O. Box 13, Belmont 78, Mass., 1960. 129 pp., paper. $18.50.)

Symposium on Bituminous Waterproofing and Roofing Materials

Eight papers presented at the Third Pacific Area National Meeting of ASTM at San Francisco, October 1959, plus a paper on weather-ometer data on coating-grade asphalts from a June meeting in Atlantic City. Five of the eight papers cover aspects of manufacture, inspection, applications and service requirements of asphalt and coal tar materials; the remaining three are of specialized experimental or theoretical interest. (Published as ASTM Special Technical Publication No. 280 by the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., 1960. 81 pp., bound. $2.50.)

Non-ASCE Meetings

American Institute of Electrical Engineers. Summer general meeting on the campus of Cornell University at Ithaca, N.Y., June 18-23, 1961.

American Shore and Beach Preservation Association. Thirty-fifth annual meeting at the Sea Scape Motel, Ocean City, Md., June 14-16, 1961. Co-hosts for the meeting are the Maryland State Roads Commission and the Delaware State Highway Department.

American Society for Engineering Education. Sixty-ninth annual meeting at the University of Kentucky, Lexington, Ky., June 26-29, 1961.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. Sixty-eighth annual meeting at the Denver Hilton Hotel, Denver, Colo., June 26-28, 1961.

American Society of Mechanical Engineers—American Institute of Chemical Engineers. Co-sponsors of the International Heat Transfer Conference at Boulder, Colo., August 28-September 1, 1961.

American Society for Testing Materials. Sixty-fourth annual meeting at the Chalfonte-Haddon Hall, Atlantic City, N.J., June 25-30, 1961.

Institute of Traffic Engineers and International Sessions in Traffic Engineering. World Traffic Engineering Conference, combined meeting in Washington, D.C., August 21-26, 1961.

International Commission on Large Dams. Seventh Large Dams Congress in Rome, Italy, June 26-July 1, 1961.

International Society of Soil Mechanics and Foundation Engineering. Fifth International Conference in Paris, France, July 17-22, 1961.

National Bituminous Concrete Association. Midyear meeting at the French Lick-Sheraton Hotel, French Lick, Ind., July 23-25.

National Society of Professional Engineers. Twenty-seventh annual meeting at the Olympic Hotel, Seattle, Wash., July 4-7, 1961.

Applications for Admission to ASCE, April 1-April 29, 1961

Applying for Member

Henry Stanley Adamick, Rolla, Mo.
Manuel Thomas Arce, Pullman, Wash.
Michael St. Clair Batson, Baltimore, Md.
Robert Wendelin Beck, Caracas, Venezuela
George Francis Berkemeyer, Pittsburgh, Pa.
Wayne Reed Broaddus, Rolla, Mo.
Frederick William Bruce, Salisbury, Southern Rhodesia
Ross Willis Buck, Atlanta, Ga.
Klemens Bylicki, Cleveland, Ohio
James Kerr Cairns, New York, N.Y.
Charles Daniel Cashman, South Bend, Ind.
Rafael Castillo, Boston, Mass.
William Cohen, Chicago, Ill.
Gerard Henri Jean Colling, Esch-Alzette, Luxembourg
Basil Constantinidis, New York, N.Y.
William Joseph Cosgrove, Westmount, Quebec, Ontario
William Kenneth De Haven, Akron, Ohio
Robert Charles Doerpinghaus, China Lake, Calif.
Frank John Dubsky, Oak Lawn, Ill.
Howard Hartman Easton, Niagara Falls, N.Y.
Carl Robert Edmonds, Grand Rapids, Mich.
Jacob Eldar, New York, N.Y.
Estes Eugene Elliott, Kansas City, Mo.
George Owen Fellers, Bethesda, Md.
Hans Heinz Fickel, Chicago, Ill.
Ross Berner Field, Los Angeles, Calif.
Thomas Francis Fitz Gerald, Tiburon, Calif.
Clark Karchow Fong, Kowloon, Hong Kong
John Williams Fowler, Memphis, Tenn.
Clyde Donald Galloway, Bartlesville, Okla.
Aurmilli Gangaiah, West Bengal, India
Eduardo Gomez-Espinos, Quito, Ecuador
Nathan Willard Goodman, Charleston, W. Va.
Henry Kyle Hickey, Oahu, Hawaii
Ralph Edward Hickey, Pittsburgh, Pa.
Levon Paul Johnson, Everett, Wash.
Haralambos Papageorghiou Karakannas, Nicosia, Cyprus
Kathirgamar Veeragathy Sinnathurai Kathiramalainathan, Lagos, Nigeria
Stanley Robert Kelley, New York, N.Y.
Joseph Christopher Kellogg, St. Paul, Minn.
Kishori Lal Khosla, Washington, D.C.
Gilbert William Kirby, Jr., Fort Leavenworth, Kans.
David Ernest Kunkel, Jr., Washington, D.C.
Harbans Lal Sharma, Denver, Colo.
Zane Patrick Laurini, Dallas, Texas
William Alvin Law, Los Angeles, Calif.
John Dale Lemons, Los Angeles, Calif.
Gerrit Francois Loedolff, Stellenbosch, South Africa
Frank Emory Lyon, Jr., San Francisco, Calif.
Matt Thomas Maxwell, San Francisco, Calif.
Glendon Raymond Mayo, Newington, Conn.
Ralph Thomas McGreal, Denver, Colo.
William Robert Mickle, Beaumont, Texas
Glenn Arthur Middleton, Jr., Kensington, Md.
Donald Barrett Miller, San Bernardino, Calif.
Edward Andrew Moe, Holyoke, Mass.
Robert Coit Mulvey, Springfield, Ill.
Daniel Francis Murphy, Montreal, Quebec, Canada
Krishna Pillai Narayana Nair, Washington, D.C.
Kasturi Lal Nanda, Punjab, India
Alfred Obrist, Syracuse, N.Y.
Frederick James O'Connell, Boston, Mass.
Irving Rudolf Ojala, Montreal, Quebec, Canada
George Edwin Olson, Washington, D.C.
Leyland Maurice Orrett, San Francisco, Calif.
Robert Louis Orsini, Torrance, Calif.
Richard Anthony Pavia, Chicago, Ill.
Paul Clifford Perry, III, Phoenix, Ariz.
Harold Burke Peterson, Phoenix, Ariz.
Marvin Millard Poss, Juneau, Alaska
Merton French Postle, Chicago, Ill.
Mandyam Kopay Rajamiyengar, Bangalore, India
Paul Joseph Rampson, Lisle, Ill.
Shankaranarayana Ramohalli Nanjunda Rao, Storrs, Conn.
Uchila Navada Parameshwar Rao, Ames, Iowa
Earl George Reynolds, Rolla, Mo.
Muhamed Ridjanovic, Iowa City, Iowa
Peter John Mackenzie Robinson, Lagos, Nigeria
Wilfred Kenneth Rodman, Washington, D.C.
Fred Ruckstuhl, Basle, Switzerland
Jack Robert Sanders, New York, N.Y.
William Francis Schlow, Holyoke, Mass.
Francis Charles Schwab, Jr., Mexico City, Mexico
John Lewis Shaddy, San Francisco, Calif.
Thomas Jacob Shafer, Baltimore, Md.
Jeng-Chong Shang, East Chicago, Ind.
Harold Valentine Swanson, East Orange, N.J.
Thomas L. Sweeney, Los Angeles, Calif.
Richard Vernon Swisshelm, Chillicothe, Ohio

(Continued on page 134)

Applications

(Continued from page 132)

Bryce Kennon Tomlin, New Orleans, La.
John Peter Ukleja, Alhambra, Calif.
Pietro Vecellio, Milano, Italy
Royal Fontaine West, Boulder City, Nev.
Dean Frederic Wheeler, Ann Arbor, Mich.
Clarence John Winkel, Wauwatosa, Wis.
Samuel Koomes Wilson, Philadelphia, Pa.
Wladyslaw Antoni Wyszkowski, Toronto, Ontario, Canada

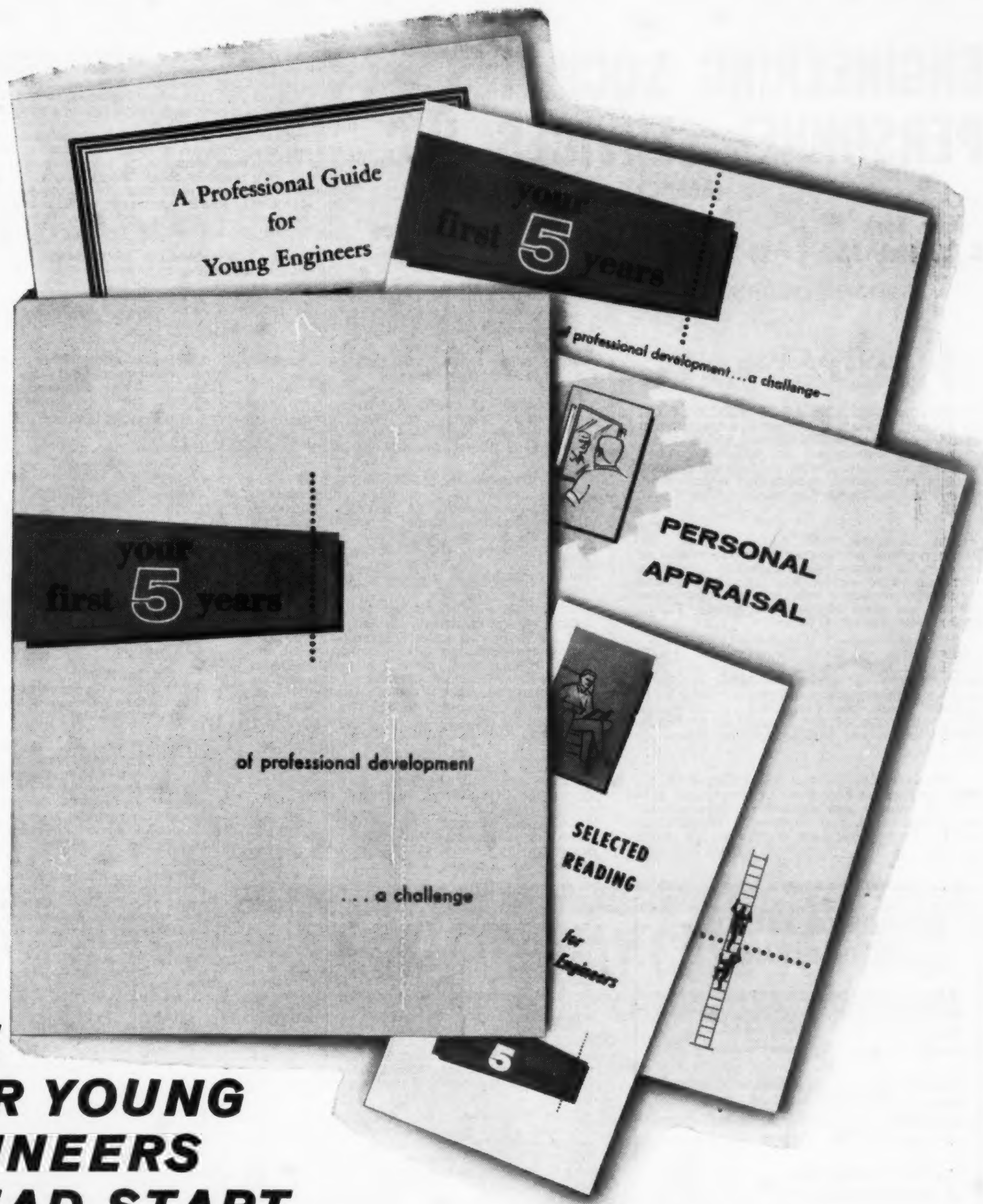
Applying for Affiliate

Earle Lewis Jones, Dallas, Texas

Applying for Associate Member

Mohamed Ahmed Abdel-Hady, Urbana, Ill.
Hoshi Rustom Aga, Pittsburgh, Pa.
Robert Corbett Aitken, Toronto, Ontario, Canada
Donald Leigh Anderson, Urbana, Ill.
John Reynolds Atkinson, Lafayette, Ind.
Robert Herbert Beer, St. Louis, Mo.
Gustovous Holmes Bell, III, Fort Bliss, Texas
Dali Ardeshir Bhandari, Toronto, Ontario, Canada
Leon Joseph Bialkowski, New York, N.Y.
Richard Bionda, New York, N.Y.
Gerald Lee Brickell, Topeka, Kans.
Cortland Albert Broberg, Juneau, Alaska
Edwin Gordon Burdette, Knoxville, Tenn.
Hector Arturo Campos Ochoa, Palo Alto, Calif.
Jerry Allen Cannon, Phoenix, Ariz.
Norman Louis Cervenka, New Orleans, La.
Joseph Thomas Clements, Jr., Little Rock, Ark.
Jose Jesus Curiel, Denver, Colo.
Alan Garnett Davenport, Ontario, Canada
Howard Judson Dohrman, Louisville, Ky.
Verne Ned Engstrom, Silver Bay, Minn.
Donald Lee Feuerstein, Oakland, Calif.
Burton Eryle Forsberg, St. Paul, Minn.
Werner Wilhelm Friederichs, Cleveland, Ohio
Duane LaVerne Georgeson, Los Angeles, Calif.
Michael Earl Giusti, San Jose, Calif.
William James Grenney, Chicago, Ill.
Maurice Ray Harlan, Austin, Texas
Kenneth Hall Hershey, Rochester, N.Y.
Wilfred Ludwig Herzog, Rochester, N.Y.
Dexter Clair Jameson, Jr., Knoxville, Tenn.
Claude John Kelly, Jr., New Orleans, La.
Marvin Leroy Knabach, Huron, S. Dak.
Felix Frank Laurus, Urbana, Ill.
Jea Myoung Lee, Seoul, Korea.
Lester Lawrence Lewis, Jr., Los Angeles, Calif.
Howard Walter Loewenstein, Syosset, N.Y.
Douglas Edward Longley, Alberta, Canada
James Frederick Luecker, Milwaukee, Wis.
Victor Manuel Luna Arenas, Guatemala City, Guatemala, Central America
Oscar Ernest Manz, Grand Forks, N. Dak.
John Andrew Massey, Jr., New York, N.Y.
David Franklin Maurer, Washington, D.C.
Hasmukh Shantilal Mehta, St. Louis, Mo.
David William Murray, Edmonton, Alberta, Canada
Robert Thomas Nowak, Pittsburgh, Pa.
Francisco Jose Orozco Ochoa, Iowa City, Iowa
Bhupendra Natverlal Parikh, Birmingham, Ala.
Robert Lombard Partie, Galeta, Calif.
Allen Jake Patterson, Birmingham, Ala.
Richard Mark Primeaux, Lake Charles, La.
Gulam Moinuddin Quraishi, Stockholm-Vallingby, Sweden
Latchmi Narine Ramdhani, Barbados, West Indies
Gary Eugene Rittenhouse, Los Angeles, Calif.
Robert Watson Roane, Jr., Chattanooga, Tenn.
Earl Rogers, San Diego, Calif.
James Rutherford, Montreal, Quebec, Canada
Toshitsugu Sakou, College Station, Texas
Omar Farouk Sati, Ann Arbor, Mich.
Philip Frank Scudieri, West Lafayette, Ind.
Chandrakant Dhunjee Shah, Columbus, Ohio
Sankaranarayanan Shanmugham, Madras State, India
Ben Arthur Shaw, Lincoln, Nebr.
John Janis Skuja, Norman, Okla.
William Ward Stewart, St. Louis, Mo.
Leslie Ralph Szalatkay, Toronto, Ontario, Canada
Bernard Wack, Grenoble, France
David Frank Wissmar, III, Honolulu, Hawaii
Jer-yann Wu, Taiwan, China

[*Applications for the grade of Associate Membership from ASCE Student Chapter Members are not listed.*]


A Professional Guide
for
Young Engineers
your first 5 years
of professional development...a challenge—
PERSONAL
APPRAISAL
your first 5 years
of professional development
. . . a challenge
SELECTED
READING
for
Engineers
5

ENGINEERING SOCIETIES PERSONNEL SERVICES, INC.

(AGENCY)

New York	Chicago	San Francisco
8 W. 40th St.	29 E. Madison St.	57 Post St.

These items are listings of the Engineering Societies Personnel Service, Inc. This Service, which cooperates with the national societies of Civil, Chemical, Electrical, Mechanical and Mining, Metallurgical and Petroleum Engineers, is available to all engineers, members or non-members, and is run on a nonprofit basis.

If you are interested in any of these listings, and are not registered, you may apply by letter or resume and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular placement fee. Upon receipt of your application a copy of our placement fee agreement, which you agree to sign and return immediately, will be mailed to you by our office. In sending applications be sure to list the key and job number.

When making application for a position include eight cents in stamps for forwarding application.

Men Available

CIVIL ENGINEER, A.M. ASCE, B.S.C.E., E.I.T. Navy Civil Engineer Corps project management officer of a public works agency, planning and coordinating maintenance and new construction for Navy activities. Desire engineering position in plant management construction organization. Salary, $6,600. Prefer Overseas or West Coast. C-682.

CIVIL ENGINEER, A.M. ASCE, B.S.C.E., 29. Desire position as sanitary engineer, municipal engineer, or construction engineer. A veteran with four years' service has varied background in industry including one year as construction engineer on plant construction. Salary, $7,200. Prefer New Jersey. C-683.

STRUCTURAL OR SALES ENGINEER, M. ASCE, B.C.E. and M.S., P.E. in New York and New Jersey. Five years' experience in the design of steel and concrete highway bridges; one year in highway design; and two years on the design and construction of air fields. Salary, $9,900. Prefer Eastern and Middle Atlantic States. C-684.

FIELD CIVIL ENGINEER, A.M. ASCE, B.S.C.E., 29. Experience as consultant in private and government housing and subdivision development; design estimating, and supervision of construction for large plant; field engineering on major highway construction. Salary, $12,000. Prefer Foreign. C-685.

UNIVERSITY TEACHING OR RESEARCH, A.M. ASCE; B.S., M.S.C.E. Two years of technical writing and 18 months on steel products design. Salary open. Prefer Midwest or West. C-686.

CIVIL ENGINEER, F. ASCE, B.S.C.E., 57. Experience includes 6 years' engineering supervision of construction on airports, highways, bridges, buildings, dams, including materials testing and concrete control; nine years on project administration, specifications, reports, technical personnel recruiting; and nine years of business management and newspaper experience. C-687.

DIRECTOR OF PLANNING, M. ASCE, B.S., B.A., M.A., P.E. in two states. Eleven years of consulting experience in city planning, urban renewal, zoning, and traffic engineering. Desire position in charge of planning for consulting firm. Salary, $12,000-$15,000. Prefer East. C-688.

SOILS AND FOUNDATION AND MATERIALS ENGINEER, M. ASCE, M.S. in soil mechanics and M.S. in highway engineering (materials), P.E., 42. Fifteen years of diversified experience in responsible charge of the design and construction supervision of buildings, highways, dams, foundations, materials, etc. Specialize in reports and specifications. Desire position preferably with consulting engineers. Will relocate anywhere, prefer foreign. Salary, $12,000-$15,000 depending on job and location. C-689.

CIVIL OR STRUCTURAL ENGINEER, A.M. ASCE, B.S.C.E., 30. Two years of experience in building construction and estimating. One year and a half of experience in design and plant engineering work including structures, piping, air conditioning, and heavy machinery installation in a nuclear reactor facility. A.C.E. "Q" clearance. Prefer New England area. C-690.

CHIEF ENGINEER OR PROJECT MANAGER, F, ASCE, B.A., M.S.C.E. Bridge design and construction, highways, railroads, project administration, specifications. Fluent Spanish, French, German. Salary open. Prefer Overseas. C-691.

CIVIL ENGINEER, A.M. ASCE, B.S.C.E., 24. One and a half years' experience in field construction and two years' experience in facilities maintenance that included management planning, allotment administration, overall and on-the-job supervision, management-employee coordination, and contract administration. C-692.

ESTIMATOR-ENGINEER, A.M. ASCE, B.S.C.E. 28. Two years of experience as assistant engineer-estimator (heavy construction); two and a half years as design engineer for steel fabricator-erector; and two years in the U.S. Army line office in engineering construction battalion. Salary, $9,500 plus bonus. Prefer St. Louis or Chicago. C-2159-Chicago.

FIELD ENGINEER, A.M. ASCE, B.S.C.E., 33. During ten years of field and office experience work has included construction staking and supervision of street, road, sewer, building and bridge construction. Also preliminary quantity estimates and contract pay estimates. Salary, $9,000. Prefer West or Southwest. C-2160-Chicago.

STRUCTURAL DESIGNER OR CIVIL ENGINEER, A.M. ASCE, B.S.C.E., 31. Four years of experience in the design and detailing of bridges, industrial type buildings and related structures for large industrial plant layouts. Also have designed and detailed docks and related harbor facilities. Salary, $7,000. Prefer Midwest. C-2161-Chicago.

MANAGER-ENGINEER, A.M. ASCE, B.S.C.E., 45. Four years as chief maintenance engineer for screw machines, presses, plating, heat treating, conveyors, boilers, plant and utilities; four years as manager of calcium carbide plant; and 13 years as superintendent and engineer of hydro-electric utility; plant lines and substations (electrical, mechanical and engineering). Salary, $11,000. Prefer Midwest. C-2162-Chicago.

ENGINEER, MANAGER, F. ASCE. Registered CE. Forty years of construction and administration experience, dealing with municipal, water supply, irrigation, flood control, waterways, highways, land development, projects. Also investigations, reports, estimates, costs. Prefer West Coast, Foreign. Salary open. Se-1548.

CIVIL ENGINEER, A.M. ASCE, CE. Professional registration in California and Nevada, 30. Eight years of experience in subdivision design, drainage, sewer design, water system and road design, aerial mapping control, land surveys, field layout and inspection, design of small earth irrigation reservoirs, irrigation and flood control studies. Prefer Northern California. Salary, $8,500. Se-1516.

SALES, M. ASCE, CE, 38. Sales experience in filters, related equipment service. Some experience in fluid mechanics, strength of materials, structures. Se-1426.

PROJECT MANAGER RESIDENT ENGINEER, M. ASCE, CE, 48. Twenty-five years of experience in construction, management in planning, design, maintenance and operation, including box culverts, retaining walls, pumping stations, underpass, structures, steel bridges, determine sources of stream pollution. Will relocate. Salary, $10,000. Se-1359.

STRUCTURAL, CIVIL, M. ASCE, CE, 38. For eleven years have had progressively responsible positions in bridge construction, inspection and in designing and supervising the design of highway structures including complete planning and lay out. Prefer Western United States. Salary, $800-$1,000. Se-1717.

Positions Available

ENGINEERING EDITOR, experienced sanitary engineer, familiar with wastewater treatment plant operation. Editorial experience desirable. Career opportunity with wastewater monthly. Salary open. Location, East. W-301.

ENGINEERS AND DESIGNERS. (*a*) Structural steel, graduate or professional engineer with a minimum of seven to ten years' experience in the design of iron and steel producing facilities. Should include knowledge of plate work, timber construction, furnace shells, columns, etc. (*b*) Structural-concrete, graduate or professional engineer with a minimum of seven to ten years of experience in the design of facilities as listed above. Should include knowledge of pilings, foundations for furnaces and stoves, footing, piers, pump pits, retaining walls, etc. Location, Midwest. W-297.

STRUCTURAL DESIGNERS, with a minimum of three years' experience. Must be capable of designing steel and concrete structures and be thoroughly experienced in heavy industrial steel and concrete. Location, Midwest. W-296 (*b*).

ENGINEERS. (*a*) Senior design engineer, qualified to design bridge structures and capable of directing activities of junior design engineers and draftsmen. Salary, $8,000-$9,000. (*b*) Junior engineers, graduate civil, with three to four years' bridge experience. Structural experience in other fields will be considered. Will do designing and drafting. Excellent opportunity for advancement. Salary, $6,000-$6,500. (*c*) Senior sanitary designer experienced in sewage treatment plants, pump stations and sewerage systems. Experience in water supply and incineration desirable but not necessary. Should be able to handle design problems under general supervision as well as supervise activities of junior designers and draftsmen. Salary, $8,000-$8,500. Location, Connecticut. W-282.

PLANT ENGINEER, civil or mechanical graduate, with at least five years' experience in plant engineering, with knowledge of plant equipment and tools. Will be responsible for supervision and coordination of tooling utilities, design and operation of plant utilities and design of plant layout and facilities, maintenance of plant and equipment, for the manufacture of jigs, fixtures and special tooling; material handling systems. Salary, $10,000. Location, Long Island, N.Y. W-281.

RESIDENT ENGINEER, civil or architectural graduate, with a minimum of five years' experience on industrial and laboratory-type buildings, to supervise the construction of same for a large American industrial corporation. Must speak, read and write German. Duration, 18 months or longer. Salary, about $12,000. Location, Switzerland. F-263.

ESTIMATOR-OFFICE ENGINEER with commercial and industrial building construction experience, to take off quantities, price jobs, do purchasing, expediting, etc. in contractor's office. Salary open. Location, Connecticut. W-248.

CIVIL ENGINEER, to do layout work—theodolite, tilting levels, etc., for company in the erecting machinery line. Will be under supervision. Salary, $5,200-$7,500. Location, Northern New Jersey. W-244.

ASSISTANTS TO CHIEF ENGINEER, graduate civil, mechanical or mining, for permanent staff openings with large mining company at operating properties; with a minimum of seven years' experience in plant maintenance, construction or design engineering or administrative engineering work at responsible level. Base salaries commensurate with experience. Married housing at $15 monthly; single room and board $40 monthly; free transportation, medical and educational facilities, plus other benefits. Location, South America. F-242(*a*).

This is only a sampling of the jobs available through the ESPS. A weekly bulletin of engineering positions open is available at a subscription rate of $4.50 per quarter or $14 per annum, payable in advance.

TEACHING PERSONNEL, Civil Engineering. (*a*) Associate professor, M.S. in C.E., with teaching or industrial experience, to instruct in soil mechanics, sanitary engineering, and basic civil engineering courses. Salary, to $7,200 for nine months, depending upon qualifications. (*b*) Associate professor, M.S. degree in civil, mechanical engineering, or engineering mechanics, with teaching or industrial experience, to instruct in engineering mechanics, statics, strength of materials and dynamics. Salary, to $7,200 for nine months, depending upon qualifications. Location, South. W-236.

PROJECT DESIGN ENGINEER, civil graduate, with three to six years' design experience in sanitary field covering sewage disposal plants and water supply systems. Salary, $7,000-$8,500. Location, Long Island, N.Y. W-233.

PLANT ENGINEERS, graduate mechanical, electrical, chemical or civil, with six or more years of experience covering installation operation and maintenance of equipment buildings and facilities. Including pumps, compressors, material handling equipment, dryers, piping, refrigeration equipment. At least two years of experience in supervision or staff position. Will prepare sketches and layout drawings for new or replacement of equipment, buildings and facilities, select proper sizing of equipment, design control system for automatic or safety operation of equipment; also report analyses and equipment specifications for a processor of food products. Develop prescribed economical methods and materials for maintenance of equipment, buildings and facilities. Must be U.S. citizen, with writing ability. Twenty-five to thirty per cent travel. Salary, about $9,500. Employer will negotiate placement fee. Location, Chicago. C-9629.

STRUCTURAL ENGINEER, M.S. or Ph.D., to conduct design and experimental studies of a variety of structures. Challenging and varied problems involving the application of high strength and construction alloy steels. Experience not required but applicant should have a thorough understanding of structural behavior. Large research laboratory. Submit resume and salary requirements. Location, western Pennsylvania. C-8598.

CHIEF DRAFTSMAN, 49. Five years or more of recent drafting room experience in supervisory position. Must have been a chief or assistant chief, with knowledge of construction aluminum fabrication and methods (shop and installation). Also have architectural knowledge relating to building sheathing (preferably metal curtain wall), and be thoroughly qualified in shop drawings, detailing, complete bills of material and take-off. For a major fabricator and installer. Relocation costs and placement fee paid. Salary, $650 plus a month. Location, San Francisco, East Bay. Sj-6035.

ESTIMATOR AND TAKE-OFF ENGINEER, to 49. Estimator must have architectural and metal shop background and be well experienced in material take-off, shop and construction, pricing for bidding, while materials take-off engineer should have experience in listing bills of material for ordering purposes. A good drafting background is desirable for both positions. For a major fabricator and installer. Relocation costs and placement fee paid. Salary about $550 a month. Location, San Francisco East Bay. Sj-6040.

ASSISTANT CIVIL ENGINEER, CE, to 40. Will consider recent graduate with some experience to represent the company, meet the public, do lay out, competition on sub-division development or improve sub-division and some drafting. Will deal in sewage system, sewage treatment plants, sub-division work for a consultant. Salary, $550-$850 a month. Location, San Francisco Bay area. Sj-6052.

OFFICE, TAKE-OFF ENGINEER, CE or equivalent, age open. Two to ten years of general construction experience relating to quantities cross sections, for cut and cover and fill. Should be able to assist in preliminary computations, firm estimates and quantities for payment on site development, foundations and general earthwork for an Architect and engineering firm. Long term heavy construction project. Salary, about $650 a month. Location, San Francisco Peninsula. Sj-6110.

STANDARDS INSPECTORS, one for San Jose and one with California registration for San Francisco, age open. Positions in testing laboratory require minimum of four years of working experience in the construction field—preferably related to building materials—and ability to meet with public and sell services. Will perform field or laboratory inspections and tests to assure conformance with established specifications on industrial, commercial or residential construction for architects, owners, city, state, county departments. Sj-6105.

SPECIAL!

ENGINEERS' INFORMATION SERVICE

As a further service to our readers we will periodically make available this new system which greatly simplifies the procedure for obtaining additional data on advertised products, new developments reported by manufacturers in "Equipment, Materials and Methods and Literature Available." Instead of writing separately to each manufacturer, you need only circle the items you would like to receive on the coupon printed below and mail it to:

ENGINEERS' INFORMATION SERVICE
CIVIL ENGINEERING
33 West 39th Street ▪ New York 18, New York

For information on products advertised in this issue, circle the appropriate page number on the left-hand coupon; for items listed in "Equipment, Materials and Methods and Literature Available," circle the appropriate key number listed on the right-hand coupon. In addition to your name and address, be sure to include your title and firm name on the coupon. All information will be sent directly to you from the manufacturers. *Not good after August 15, 1961.*

June, 1961—Products Advertised

ENGINEER'S INFORMATION SERVICE *Date*......................
CIVIL ENGINEERING
33 West 39th Street
New York 18, New York

PLEASE SEND me more complete engineering information on the products advertised in the pages circled below.

IFC	28	120	142TL
1	30	121	142BL
2	32	122	142OBL
4, 5	78, 79	123	143
6	81	124	144L
7	82, 83	127	144BR
8, 9	85	128L	145
10, 11	86, 87	128R	146TL
12	89	129	146BL
13	91	130L	146OBL
14, 15	93	130R	147
16, 17	95	131	148L
18	105	132	148TL
19	111	133	148BL
20L	112	134	149R
20BR	113	135	149TL
21	114	137TR	149BL
22, 23	115	137BR	150
24, 25	116	140BL	151
26	117	140BR	IBC
27	119	141	OBC

Note: The following code identifies the location of the ad when more than one advertisement appears on a page: T-top, B-bottom, L-left, R-right, OBL-outside bottom left, IFC-inside front cover, IBC-inside back cover, OBC-outside back cover.

Name ....
Title ....
Company ....
Address ....
City, Zone and State ....

June, 1961—Equipment, Materials, Etc.

ENGINEER'S INFORMATION SERVICE *Date*......................
CIVIL ENGINEERING
33 West 39th Street
New York 18, New York

PLEASE SEND me more complete engineering information on the items featured below.

CE-1	CE-13	CE-25	CE-37
CE-2	CE-14	CE-26	CE-38
CE-3	CE-15	CE-27	CE-39
CE-4	CE-16	CE-28	CE-40
CE-5	CE-17	CE-29	CE-41
CE-6	CE-18	CE-30	CE-42
CE-7	CE-19	CE-31	CE-43
CE-8	CE-20	CE-32	CE-44
CE-9	CE-21	CE-33	CE-45
CE-10	CE-22	CE-34	CE-46
CE-11	CE-23	CE-35	CE-47
CE-12	CE-24	CE-36	CE-48

Note: Code number identifies location of item in Equipment, Materials and Methods, Literature Available and Films Available, starting on page 139.

Name ....
Title ....
Company ....
Address ....
City, Zone and State ....

EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Wire Cost Reduced

A LOWER COST METHOD of packaging has been developed by John A. Roebling's Sons Division, the Colorado Fuel and Iron Corp., Trenton 2, New Jersey, for transporting prestressed concrete strand. The strand is shipped to the prestressed fabricator in a bundled 6000-lb package (Fig. I), in which lengths per package have been increased to 12,000, 16,000 and 22,000 ft for ½, 7/16 and ⅜ in. strand, respectively. The fabricator uses a take-apart, steel pay-off reel of the same outside dimensions as the standard wood reels (Fig. II). After the steel reel is assembled on the package (Fig. III), it is handled in the same way as the present wood reels, but because of the greater footage per package, reels have to be replaced in racks 30 percent fewer times. The package is of significant importance, since it makes possible a reduction in the selling price of Roebling 7-wire, stress-relieved strand used as the tensioning element in prestressed concrete structurals. **—CE-1**

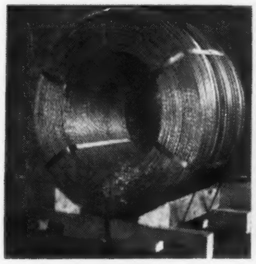


Fig. I

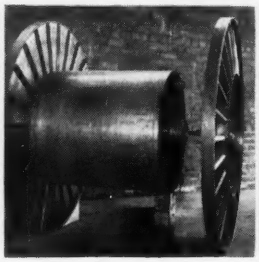


Fig. II

Fig. III

Pipe-Leak Detector

A COMBINATION PIPE finder-leak detector to feature completely transistorized circuits has been developed by Fisher Research Lab., Inc., Palo Alto, California. Called the "Master", the instrument has independent circuits for each operation. Materials such as printed circuits, indestructible fiberglass cased, single turn solid aluminum detecting loops, have been used to produce a greater accuracy, depth penetration and dependability under the most rugged field conditions. Other features include a built-in, 4-transistor amplifier circuit for the leak detector making it completely independent of the pipe finder circuit. An improved piezoelectric crystal increases leak detection sensitivity. **—CE-2**

Compact Tool Shop

"Add-A-Tool", the recent introduction of Yuba Power Products, 800 Evans St., Cincinnati 4, Ohio, offers the woodworker the compactness of many tools on one stand. The single Mount transforms the radial arm saw into a jointer, bandsaw, belt sander and compressor-sprayer, allowing woodworkers to perform all operations of a project, from simple cross cuts to finishing sanding and spray painting. The sawing operations, including mitering, bevel cutting and dadoing, are performed by a 9 in. blade, which can crosscut 20⅝ in. wide into 1 in. stock and rip to the center of a 54 in. panel. The power is supplied to the complementary tools by the Sawsmith Motor. Convenient controls include the speed dial which has seven speeds from 1700 to 6400 rpm. **—CE-3**

Deck Hangers

UNIVERSAL FORM CLAMP CO., 1238 N. Kostner, Chicago, Ill., has developed two deck hangers for slab construction over steel or concrete beams. The standard hanger is used on all interior beams and the fascia hanger is for use on exterior beams (called Uni-Deck Hangers). Both are available in a variety of sizes for various flange widths. Two ½ in. coil nuts are furnished with each hanger. **—CE-4**

Table Feeder

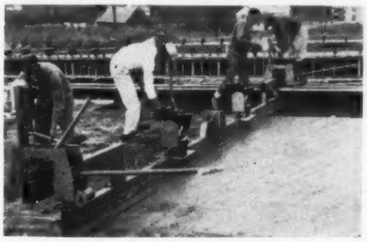
A TABLE FEEDER for dry materials, self-contained, Model 23-02, is produced by B-I-F Industries, Providence 1, Rhode Island. Suitable for feeding practically any granular or powdered dry material, its light-weight construction (only 150 lb) allows installation in any convenient location, such as a laboratory bench. It features a feed scroll and adjustable gate which assures uniform volumetric feeding, regardless of changing flow characteristics of the material. The hopper can be readily loaded without interrupting feeder operation. Micrometer gate adjustments provide a 20:1 feeding range between minimum and maximum for which the feeder is geared. Change gears permit feed rates from 20 to 1700 cu in. per hour, depending on material characteristics. **—CE-5**

Hub-End Iron-Body Valve

THE HUB-END IRON-BODY VALVE for use with concrete pressure pipe was developed and is manufactured by M&H Valve and Fittings Company, Anniston, Alabama. It employs large O-Ring gaskets to connect the valve hubs to the concrete pipe. The valve eliminates the need of adapters when installing valves in a concrete pipe line, thus saving the installation and cost of adapters. It meets AWWA standards and is furnished in sizes 16 in. through 24 in. The valve gaskets are the same as the gaskets used for the concrete pipe line joints. Hydrostatic tests and field installations show the joint to be leakproof and completely satisfactory. **—CE-6**

All-Steel Vibrating Screeds

VIBRATING SCREEDS, THE MODELS SSG AND SASG are extremely versatile for concrete paving in that they are adjustable for length, speed, amplitude, and crown. The SSG Screed is ideal for striking off slabs of any length up to 30 ft and with a crown adjustment of up to .025 in. per ft of beam length (¾ in. for 30 ft span). The screed package consists of 3 hp gas driven adjustable amplitude screed power pak, two heavy duty lift up roller assemblies with 9:1 ratio winches, and a double flange, adjustable crown all-steel beam. The SASG Screed is designed to strike off slabs which require a greater crown than .025 in. per ft of beam length at center when the beam is longer than 30 ft. It is similar to the SSG screed except it comes with two 3 hp adjustable amplitude screed power paks instead of one. Stow Mfg. Co., 443 State Street, Binghamton, N.Y. **—CE-7**



Screed In Action

Roller Seals

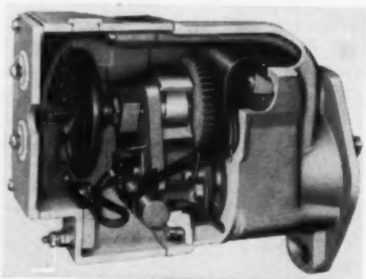
TRACK ROLLER SEALS of the metal-to-metal, cartridge-type, which increase the track roller lubrication interval to 1,000 hours, are available for International TD-9 crawler tractors, it is announced by International Harvester Company's Construction Equipment Division, 180 N. Michigan Ave., Chicago 1, Illinois. The metal-to-metal sealing surfaces assure positive protection against lubrication leakage and entrance of abrasive foreign materials. The new seals are similar to the type used successfully, under severest mud and water conditions, on larger crawlers. —CE-8

Electronic Distance Measuring System

THE ELECTROTAPE SYSTEM consists of two tripod-mounted instruments placed at opposite ends of a baseline to be measured. It measures the time it takes for a radio wave to travel from one unit to the other and back again. When the time is known, the distance is easily calculated. The instrument, introduced by Cubic Corp., 5575 Kearney Villa Rd., San Diego 11, Calif., is self-contained, with a built-in antenna-reflector, power supply and radio telephone. The readout appears as numbers on a counter, directly in centimeters. Slope distances, based on standard atmosphere; corrections for non-standard conditions (temperature, barometric pressure, humidity), are determined from a nomograph, which is furnished with Electrotape. —CE-9

Submersible Pumps

NON-CLOG SUBMERSIBLE PUMPS announced by Fairbanks, Morse & Co., 600 S. Michigan Avenue, Chicago, Ill., are especially designed to handle large solids and stringy materials, such as industrial material or wastes, raw or treated sewage, light sludge and slurries. These pump and motor units are equipped with a one-piece cast iron impeller either in two-blade design or, where excessive clogging would otherwise be encountered, in the bladeless impeller design. The pumps come in 2, 3, and 4 in. sizes. The totally enclosed non-ventilated induction motor, available in ¾ to 7½ hp, has an oil-filled interior and finned exterior for rapid cooling in underwater operation. —CE-10



Cutaway of FM-LTR Pump

Power Operator for Rolling Doors

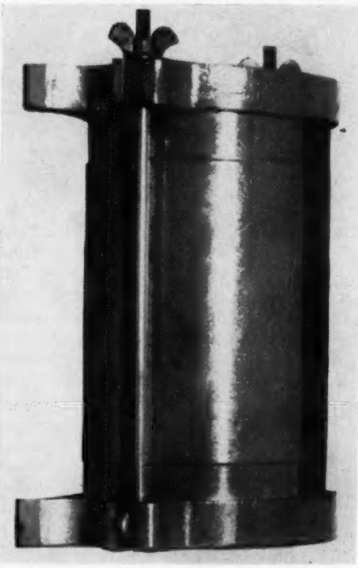
AN ELECTRIC POWER OPERATOR for use with metal rolling doors has just been announced by The Kinnear Manufacturing Co., Fields Ave., Columbus, Ohio. This unit is designed so that the electric motor can be easily removed, without disturbing the operation of an auxiliary hand-chain operator provided for emergency manual operation of the door. The unit is offered in seven sizes, with motor capacities to suit door size and for any of the more common characteristics. Other features include: a centrifugal clutch which transmits the motion of the motor to the door without shock and prevents stalling or damage to the motor from overload, a safety attachment which will reverse door travel if anything comes in the path of the curtain and a standard monetary three push-button control. Design provides for easy installation, being adaptable to either wall or bracket mounting and permitting the wiring of controls to a terminal strip in the field. —CE-11

EQUIPMENT MATERIALS and METHODS

(continued)

Cylinder Mold Eliminates Capping

THE FORNEY HORIZONTAL CYLINDER MOLD, Forney's Inc., Tester Div., Box 310, New Castle, Pa., is designed to produce concrete test cylinders with perfectly square and plane ends so that the capping procedure can be eliminated



Simplifies Test Molding

thus gaining quality control and de-tensioning. Filled through the slot on top and rodded or vibrated in the usual manner, the mold has accurately machined end plates which produce perfect ends on the specimen. When the end plates are knocked off, the barrel springs open enough to release the specimen.
—CE-12

Please give your complete address.

Drills and Tappers

THE "TRU-FEED" DRILL is a compact, rugged pneumatic powered tool using a precision leadscrew to provide positive mechanical feed in drilling holes. The "Tru-Thread" Tapper is designed for production thread cutting on either portable or stationary applications and for sizes from 0 to 1 in. diameter. A "controlled pitch" leadscrew feed prevents tearing or stripping of threads and tap breakage. Both models drill holes from ½ to 1¼ in. diameters, have a wide range of spindle speeds (75 to 4400 rpm), and are operated automatically. Gardner-Denver Co., Quincy, Illinois.
—CE-13

EQUIPMENT MATERIALS and METHODS

(continued)

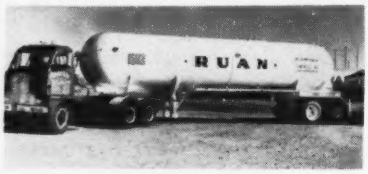
Fast Copying Machine

FOR THE FIRST TIME, new processes are being introduced for the reproduction of commercial quality glossy prints in a standard office copying machine. These prints, sharp enough for halftone reproduction, are produced in 10 sec each for less than $.10 in paper costs. Three types of copying processes developed in France, by the Polyclair and Guilleminot Corporation, will reproduce in any office, commercial type glossy prints, as well as stats, translucent master, micro-film blow-backs, and paper, in a process competitive in speed, cost and simplicity of operation with processes available for standard copying today. The Burton Mount Corporation, 2147 Jericho Turnpike, New Hyde Park, L.I., N.Y., has obtained exclusive U. S. franchise to introduce the processes in this country. **—CE-14**

Polymicro Copier

Trailer Tanks For Pipeline

THE PITTSBURGH-DES MOINES STEEL COMPANY, Neville Island, Pittsburgh 25, Pa., has completed the building of 45 trailer tanks which are being used to transport propane from various terminals of the 2,317-mile Mid-America pipeline from Texas to Minnesota. The high-strength T-1 steel is essential in these tanks since they transport propane and other liquids under pressure. Each of these 10,000-gal tanks is 7.4 ft O.D. and from 35 to 40 ft long. All welds were completely X-rayed and each tank was stress-relieved and hydrostatically tested in the shop. **—CE-15**



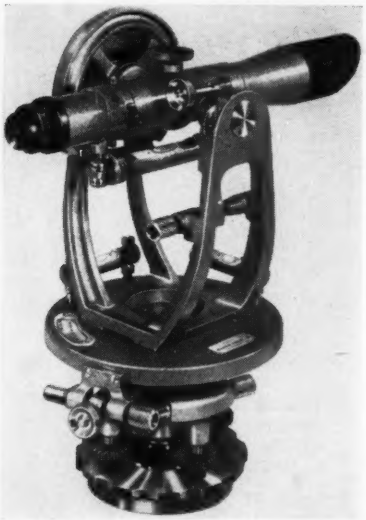
Steel Trailer Tank

EQUIPMENT MATERIALS and METHODS

(continued)

Contractor's and Builder's Transit

AN AMERICAN MADE TRANSIT, entirely of brass and bronze with a special steel center, has been announced by the Warren-Knight Co., 136 N. 12 St., Phila. 7, Pa. The internal focusing, 24 power, erecting telescope can be plunged between standards, like an Engineer's



Transit, for back sights. It has full vertical and horizontal circles, engine divided on a new tarnish proof metal. Both can be read to single minutes with double verniers. There are clamp and tangent screws for both the center and the horizontal circles as well as the telescope. —CE-16

Turn to page 138 and order your literature.

Non-Linear Chart

LEUPOLD & STEVENS INSTRUMENTS, INC., 4445 N.E. Gilson St., Portland 13, Oregon, has a non-linear chart, F-8, for use with the Stevens Type F Recorder for producing a record in units of flow through a 90 deg V-notch weir. The Recorders equipped with this chart, operating at English 1:1 ratio gage scale and responding to head variations in a 90 deg V-notch weir, records directly in mgd or gpm without requiring reference to a conversion chart. A depth in feet scale at the left chart margin facilitates setting the recorder to the depth measured in the weir and allows interpreting the record in units of head if desired. —CE-17

EQUIPMENT, MATERIALS and METHODS

(continued)

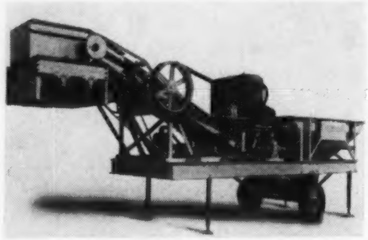
Adjustable Pumps

USE OF TWO ACAP PUMPS, produced by the Allis-Chalmers Mfg. Co., Milwaukee 1, Wisconsin, rated 1200 gpm, 64 ft head, down to 800 gpm at 23 ft head, will eliminate need for a costly overflow pipe-line by-pass. Each unit will be driven by a 40 hp, 1160 rpm totally enclosed, fan-cooled motor and will pump waste sludge containing 3 to 5 percent solids from treatment storage in the main plant some 800 ft away. The pumps, with the aid of remote control air positioners to regulate capacities, will maintain a constant level in the supply tank in the new disposal plant, of the Metropolitan Sanitary District of Greater Chicago, which is scheduled to go into operation this year. —CE-18

PLEASE PRINT NAME CLEARLY

Base Mixers

FIVE STABILIZED BASE MIXERS, models, 1A, 1B, 1C, 1D and 2A, have been announced by Iowa Mfg. Company, Cedar Rapids, Iowa. The Model 1 series are compact, highly portable units with either single shaft or twin shaft pugmills. The Model 1A and 1C are single shaft models with capacities of 150-200 and 250-300 tph respectively and 1B and 1D are twin shaft models with 200-250 and 300-450 tph respectively. The model 2A is a



Front-End Loader Mixer

rugged high capacity unit, 300 to 600 tph, designed primarily for stationary installation. All models have 6½ cu yd bins with a long side dimension for ease of loading with a front-end loader. —CE-19

EQUIPMENT MATERIALS and METHODS

(continued)

Non-Disbonding Coating

A COUPLING WITH A PERMANENT COATING which will not disbond in any weather is concealed by a useful but expendable outer shell, while independently assuring 99.2% protection against corrosion-causing breaks in the coating. Electrical continuity of the coupling achieved through a special bonding de-

Epoxy and Bituminous Coated Coupling

vice assures cathodic protection against corrosion, and installation procedures are simplified. Produced by Dresser Mfg. Division, Bradford, Penn., this hot-applied bituminous coating, used in a newly discovered way in combination with an epoxy and a phenolic results in an improved method of adhesion and provides a permanent sub-layer, non-disbondable coating and the additional development of factory assembly improved the ease of field installation and showed substantial construction savings. —CE-20

**PLEASE BE PATIENT
YOUR REQUESTS TAKE TIME**

Precision Tank Gaging

THE TANK GAGING of problem liquids in a different way has been announced by Exactel Instrument Co., Mountain View, California. Chemicals, high temperature liquids, liquids stored under pressure and volatile liquids have been highly satisfactorily gaged by mercurial Servomano-

(Continued on page 146)

EQUIPMENT MATERIALS and METHODS

(continued)

meters operating on the purge bubbler principle.

In principle, the pressure at the exhaust of the bubbler line at the bottom of the tank equals the head pressure of the liquid measured and is therefore converted to in. of mercury with readout in appropriate direct units. The only material in contact with the material measured is a tube extending to the bottom of the tank and the bubbling gas, generally dry nitrogen.

A fundamental advantage is that it is basically a weighing process, sensing the pressure at the bottom of the vessel, so it is not subject to error caused by temperature variations in the measured media.

Output data is generally in logical units such as barrels, cu ft, ft of depth, etc. to five significant figures. The Servomanometer type generally employed is of 32-in. range and may be located considerably remote from the measured vessel, with the bubbler line leading to the vessel.

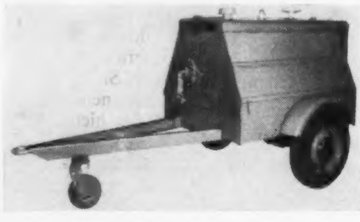
The principle was originally developed for measuring tank content in residual fuel oil tanks as in refineries and electrical power generating stations.

—CE-21

In filling out the coupon, please print clearly and be sure that you furnish a complete address.

Portable Compressor

Single stage portable compressors, which for the first time will be available in sizes up to 250 ft, has been introduced by the Worthington Corp., Harrison, New Jersey. The Mono-Rotor, as it is called, has just 79 parts as compared to 213 parts in the old two-rotor, two-



Mono-Rotor Compressor

stage models, thus making it 20 per cent lighter-designed for improved towing and tracking. It features a rotor-to-cylinder oil sealing, a clutch for cold weather start-up and engine longevity and a third wheel for easier handling. Available in 85, 125 and 250 ft sizes, it is the first line to carry a full year warranty.

—CE-22

Literature Available

MIXED FLOW VOLUTE PUMPS—A 6-page catalog, offered by C. H. Wheeler Mfg. Co., 19th & Lehigh, Philadelphia 32, Pa., describes low and high head mixed flow volute pumps for sewage disposal, drainage, flood control, irrigation, raw water pumping, or for any relatively clear liquids. Design and construction details for both horizontal and vertical mixed flow volute pumps are included. Units are built in 12 through 72 in. sizes, and in 3000 to 150,000 gpm capacities. **—CE-23**

VINYL LINERS—A flyer containing information on Vinyl Reservoir Liners is now available from Agricultural Plastics Co., 3935 Seyburn Avenue, Detroit 14, Michigan. This black vinyl film liner has been installed in a number of reservoirs for which the installation procedure and description are given. **—CE-24**

COMPARATIVE PAVEMENT COSTS ON INTERSTATE-DEFENSE AND PRIMARY ROADS—This 48-page brochure, published by The Asphalt Institute, University of Maryland, College Park, Maryland, offers a comparison of costs by pavement type on interstate and primary highway projects in nearly all states. Pavement costs are quoted directly from bid prices—for projects on the same road, or for equal design on comparable projects in the same area. It is illustrated with photographs and location maps. **—CE-25**

NUCLEAR MOISTURE AND DENSITY INSTRUMENTATION—A 6-page brochure, available from Nuclear-Chicago Corp., 333 E. Howard Ave. at Nuclear Dr., Des Plaines, Ill., describes how to use nuclear gauges for rapid field determination of moisture and density in soils, aggregates, concrete, asphalt, etc. The nuclear moisture and density probes may be used on the surface of the material being tested or may be inserted into bore holes through access tubing to measure the moisture or density at selected depths to 200 ft below the surface. It is profusely illustrated and contains full specifications of the gauge. **—CE-26**

COVERAGE MAP—Fairchild Aerial Surveys, Div. Fairchild Camera and Instrument Corp., 224 East 11th St., Los Angeles 15, Calif., offers their new "Western States Coverage Map", which shows available photographic and magnetometer survey coverage in the Western United States and a list of services available. **—CE-27**

GEODETIC INSTRUMENTS—This 8-page illustrated brochure, offered by the AGA Corp. of America, P. O. Box 447, South Plainfield, New Jersey, describes the Geodimeter, an electronic surveying instrument used for accurate measurement of unknown distances: what it is, how it works, and how it is employed. Detailed descriptions of Models 2, 3 and 4 are included, giving specifications and capabilities of each. **—CE-28**

Literature Available

FOUNDATION PILE FITTINGS—Brochures and catalogs, from Associated Pipe & Fitting Co., Inc., 262 Rutherford Blvd., Clifton, N.J., are available for points, boots, shoes, splicer sleeves, joiners and connectors for H-piles, timber piles, pipe piles and mandril driven shell piles, all designed to increase structural value of piles. They are economical and simple to install. —CE-29

PRICELESS WATER—An 84-page book produced by Johns-Manville, 22 E. 40 St., New York, N.Y., to advance water service throughout the nation, presents the need for good facilities . . . their benefits to the individual, community, business, and industry . . . offers an extensive check list for evaluation of present water utility . . . plus . . . a step by step outline of what can be done to promote and obtain good water service. —CE-30

RIVER CROSSING PIPE—American Molox Ball Joint Pipe for river crossings and other submarine service is the subject of a new catalog now available from the American Cast Iron Pipe Company, Box 2603, Birmingham, Alabama. The 32-page illustrated catalog contains a detailed description of the joint, various applications and installation methods, dimensions, weight tables and assembly instructions. —CE-31

SEVEN STEPS TO IMPROVED CONCRETE FLOORS—A seven-step procedure for repairing damaged floors by using Embeco pre-mixed mortar is explained and depicted in this publication, EPMM-4, from Master Builder Co., Cleveland 18, Ohio. How strong, tough, non-shrink repairs can be made to cracks, holes and ruts in concrete floors is described thoroughly. Strength comparisons between plain mortar and pre-mixed mortar are also discussed. —CE-32

GRATING AND TREADS—Kerrigan Iron Works Company, Nashville, Tenn., has three new brochures, Steel Grating and Treads, Aluminum Grating and Open Steel Bridge Flooring. All the brochures contain specifications, table of weights and safety measurements. —CE-33

BASEMENT FORMS—A folder featuring Basement Forms for pouring concrete house foundations is available from Economy Forms Corp., Box 128, Highland Park Station, Des Moines, Iowa. It shows standard size form measuring 24 x 88 in., pictures the form in use and offers free ad mats for contractor's use. —CE-34

STEEL CONSTRUCTION—Yuba Consolidated Industries, Inc., 1 Bush Street, San Francisco 4, California, offers a booklet containing illustrations of Structural Steel Construction, Plate Steel Construction, Equipment Installation and Industrial Maintenance. Information is included for industry, engineering contractors and general contractors. —CE-35

Literature Available

EXPANSION PLATES & BUSHINGS—Manual No. 55, offered by Lubrite Div., Merriman Bros., Inc., 189 Amory Street, Boston, Mass., contains complete information, technical data, and specifications about Lubrite self-lubricating expansion plates and bushings for bridges, buildings, refinery equipment, chemical processing equipment, high temperature missile and atomic applications. **—CE-36**

GEOTECHNICS AND RESOURCES—Examining, measuring, and evaluating the earth by means of aerial photographic interpretation, geophysics, aerotechnics and other advanced scientific and engineering techniques; and the value of these practices, are all described in a 32-page brochure concerning the services of Geotechnics and Resources, Inc., Westchester County Airport, White Plains, New York. **—CE-37**

LUBE OIL BOOKLET—The 6th edition of "Lubricating Oils for Industrial and Heavy-Duty Automotive Engines" has just been released by the Internal Combustion Engine Institute, Chicago, Illinois. This booklet lists, in 75 pages, the names of approximately 750 oil companies and the brands of their oils which they each guarantee meet the test requirements of U. S. Military Specification MIL-L-2104A and/or British Defence Specification DEF/2101B, as well as the Supplement 1 (S-1) and the Series 3 (Caterpillar) test specifications. **—CE-38**

ROLLERS—This handy specifications guide, DM-30-A, shows the line of 18 rollers, attachments and 3-wheel, tandem and pneumatic tire rollers, offered by The Galion Iron Works & Mfg. Co., Galion, Ohio. **—CE-39**

COMMERCIAL HELICOPTERS—A brochure describing the role of the commercial helicopter models in heavy construction including missile site construction and support is now available from Hiller Aircraft Corp., Palo Alto, Calif. It covers the 3- and 4- place series helicopters in pre-bid site inspection, aerial survey, construction of powerlines, dams, highways, transmission towers, bridges and missile site construction. **—CE-40**

CONSTRUCTION AID—The 12-page bulletin, 300-P14, entitled Structural Components is now available from Commercial Shearing & Stamping Company, Youngstown, Ohio. Illustrations include liner plates, ring walers, anchor bolts, etc. Case history photos and brief facts on their projects are also featured. **—CE-41**

BOLTLESS JOINT PIPE—An 8-page booklet from U. S. Pipe & Foundry Co., 3300 First Avenue, N., Birmingham 2, Alabama, describes the Usiflex boltless flexible joint pipe. The joint is simple, rugged, locked against pull-out and assembled without the use of bolts. It is ideally suited for submarine installations. **—CE-42**

Literature Available

CONCRETE ADMIXTURES—A guide for specification writers and contractors on concrete admixtures, iron-armoured floor products, grouting and waterproofing materials and other related products for improving concrete and mortar is available from The Master Builders Company, Cleveland 18, Ohio. It contains 10 pages of comprehensive guide specifications for concrete, concrete floors, colored concrete floors, equipment grouting and masonry mortar, based on current ASTM and ACI standards. **—CE-43**

AUTOCENTERING—The reprint from "Surveying and Mapping" describing interchange of theodolite, targets, subtense bar, or other accessories on tripods with strict, automatically maintained centering, has been released by Kern Instruments, Inc., 120 Grand Street, White Plains, New York. The article describes many applications of Autocentering, where time is saved and accuracy increased. **—CE-44**

ECONO-BEAM GUARDRAIL—This product is described in a folder offered by Armco Drainage & Metal Products, Inc., Product Information Service, Dept. EC-61, 703 Curtis Street, Middletown, Ohio. It provides low-cost protection where slow traffic speeds do not warrant rugged highway guardrail, and is strong yet light in weight and is supplied in 12.5 and 25 ft lengths. It is made of a special zinc-coated steel for durability and low-cost maintenance. **—CE-45**

ALL-PURPOSE DRILL—The Acker Ambassador Core Drill for drilling or coring concrete, tile, glass, rock and reinforced masonry, is described and illustrated in Bulletin 27 offered by the Acker Drill Co., Inc., Box 830, Scranton 2, Pa. The bulletin contains specifications and sizes pertaining to the drill and various bits and a list of accessories included at the end of the booklet. **—CE-46**

UNDERGROUND HAULAGE EQUIPMENT—A wide variety of tunnel haulage equipment is illustrated and described in the 4-page bulletin No. 18-c offered by Mayo Tunnel & Mine Equipment, Lancaster, Pa. Diesel and Battery locomotives for tunnel and mine operations, and many kinds and sizes of tunnel cars are featured. Also shown are drill jumbos, automatic couplers, car passers, grouters and pea shooters. **—CE-47**

GENERAL SERVICES BULLETIN—A 4-page, color brochure, offered by Layne & Bowler, Inc., Memphis 8, Tennessee, gives general facts and information on water well systems, water pumps, well drilling and allied water services and equipment for municipalities, industry and agriculture. Additional bulletins are listed for detailed information on well drilling, well casing and screen, pumps, chemical treatment of water wells and water treatment. **—CE-48**

PROCEEDINGS AVAILABLE

April

Journals: Engineering Mechanics, Soil Mechanics and Foundations, Structural.

2792. Symposium on Grouting: Grouting at Fort Campbell Theatre Building, by B. E. Clark. (SM) Descriptions of the occurrence, exploration, and grouting treatment of a sink under construction are studied.

2793. Symposium on Grouting: Grouting to Prevent Vibration of Machinery Foundations, by John P. Gnaedinger. (SM) A technique for reducing the amplitude of vibrations of an expander and two compressor foundations to tolerate magnitudes is presented.

2794. Symposium on Grouting: Research in Foundation Groutings with Cement, by Thomas B. Kennedy. (SM) This paper presents a review of the materials, mixes, techniques, equipment, and problems of foundation grouting.

2795. Symposium on Grouting: Investigation of Sand-Cement Grouts, by James M. Polatty. (SM) This paper is a presentation of the results and effects of an investigation of various types and graduations of sand for portland-cement grouts

2696. Construction of Rocky Reach Grouted Cutoff, by W. F. Swiger. (SM) This paper describes the design and construction, by grouting, of a cutoff constructed across a series of openwork gravels to control seepage.

2797. Grouting in Flowing Water and Stratified Deposits, by R. H. Karol and A. M. Swift. (SM) Experimentation defining the modification that ground water flow and stratification make on the anticipated shape and size of a grouted mass is examined.

2798. Two-Dimensional Flow with Corner Eddies, by Aris C. Spengos. (EM) Flow in a two-dimensional channel with an asymmetrical abrupt contraction is analyzed.

2799. Brittle Fractures Explained by Negative Residuals, by L. E. Grinter. (EM) A theoretical explanation is presented with the hypothesis that residual lateral compressive stresses may suppress ductility across a notch and permit the occurrance of cleavage fracture.

2800. Bending of Beams Resting on Isotropic Elastic Solid, by Aleksandar B. Vesic. (EM) The Biot's solution for bending beams resting on isotropic elastic solids is reviewed, and a thorough investigation of the conventional approach by means of the coefficient of subgrade reaction k is presented.

2801. Continuous Beam-Columns on Elastic Foundation, by S. L. Lee, T. M. Wang, and J. S. Kao. (EM) An analysis is presented of continuous beam-columns on elastic foundation by means of the slope-deflection equations and related problems.

2802. Strength and Design of Metal Beam-Columns, by Walter J. Austin. (ST) A review is presented of the state of knowledge, as of 1961, relating to behavior, strength, and design of metal members subjected to combined axial compression and bending.

2803. Discussion of Proceedings Paper 2497, 2616, 2627, 2690. (EM) Alfred H. S. Ang on 2497. Gerrit H. Toebes on 2616. L W. Gold, R. H. Wood on 2627. N. C. Lind and D. T. Wright, Daniel Frederick on 2690.

2804. Discussion of Proceedings Paper 2294, 2368, 2501, 2564, 2623, 2625. (SM) James K. Mitchell and Dean R. Freitag on 2294. W. Heukelom and C. R. Foster on 2368. John A. Horn on 2501. Bobby Ott Hardin, V. A. Smoots, J. F. Stickel, and J. A. Fischer, S. D. Wilson and R. P. Miller on 2564. H. J. Gibbs on 2623. Laurits Bjerrum and Kwan Yee Lo, W. M. Kirkpatrick, A. A. Eremin, Andrew W. Jenike on 2625.

2805. Discussion of Proceedings Paper 2435, 2461, 2528, 2630, 2634, 2643, 2678, 2680, 2703, 2712, 2715. (ST) H. C. S. Thom on 2435. W. H. Gardner, Jr., and Donald H. Kline on 2461. Eduard Luss on 2528. A. A. Eremin on 2630. H. L. Su on 2634. A. R. Oliver and Alixis Ostapenko on 2643. Jack R. Benjamin on 2678. Clarence J. Derrick on 2680. Glen V. Berg on 2703. Steven J. Fenves on 2712. Jack R. Benjamin on 2715.

May

Journals: Hydraulics, Sanitary Engineering, Waterways and Harbors.

2806. Sanitary Engineering Comes of Age, by P. H. Mc Gauhey. (SA) The status of sanitary engineering on the graduate level and as a profession is analyzed.

INSTRUCTIONS

1. Every ASCE member can be registered in two of the Technical Divisions and receive automatically all papers sponsored by those Divisions. **Such registration will be effective 30 days after the receipt of the registration form.**

2. In addition to those papers sponsored by the Divisions in which he is registered, a member is entitled to 100 different papers during a fiscal year beginning October 1.

3. Members' accounts will be charged 25¢ each for additional duplicate copies of a paper and for papers in excess of his free allotment.

4. Papers should be ordered by serial number. The member should keep a record of papers ordered to avoid unwanted duplication.

5. Non-members of the Society may order copies of Proceedings papers by letter with remittance of 50¢ per copy; members of Student Chapters, 25¢ per copy.

Standing orders for all Papers in any calendar year may be entered at the following annual rates: Members of ASCE, $15.00; members of Student Chapters, $15.00; non-members, $40.00; libraries, $25.00.

Transactions. Specially selected Proceedings papers with discussions will be included in Transactions. Annual volumes of Transactions will continue to be available at the current established annual subscription rates.

	To Members	To Non-Members
Morocco-grained binding	$4.00	$18.00
Cloth binding	3.00	17.00
Paper Binding	2.00	16.00

KEY TO TECHNICAL DIVISION SPONSORSHIP

(AT) Air Transport
(CP) City Planning
(CO) Construction
(EM) Engineering Mechanics
(HY) Hydraulics
(HW) Highway
(IR) Irrigation and Drainage
(PL) Pipeline
(PO) Power
(PP) Professional Practice
(SA) Sanitary Engineering
(SM) Soil Mechanics and Foundations
(ST) Structural
(SU) Surveying and Mapping
(WW) Waterways and Harbors

PROCEEDINGS AVAILABLE

2807. Design and Stability Considerations for Unique Pier, by James Michalos and David P. Billington. (WW) Design and stability of Pier 40 in New York City are described.

2808. Mechanics of Washout of an Erodible Fuse Plug, by E. Roy Tinney and H. Y. Hsu. (HY) Laboratory and field experiments are described which were undertaken to demonstrate the feasibility of a fuse plug in the spillway of a major dam.

2809. Economics of River Bank Stabilization, by Charles Senour. (WW) The determination of costs pertaining to stabilization of the caving banks of an alluvial river and its advantages and disadvantages are presented.

2810. Seepage Through Layered Anisotropic Porous Media, by David K. Todd and Jacob Bear. (HY) The paper summarizes an investigation of seepage from leveed rivers into low-lying adjoining agricultural lands.

2811. Cathodic Protection of Marine Terminal Facilities, by Joseph Milano. (WW) The use of cathodic protection to inhibit corrosion of steel pilings at the Port of New York Authority Marine Terminal Facilities is outlined.

2812. Fish Passage Through Hydraulic Turbines, by Glenn H. Von Gunten. (HY) This paper reviews the basic concepts of fish passage through dams and their significance with particular reference given to passage through turbines.

2813. Hurricane Winds for Design Along the New England Coast, by C. S. Gilman and V. A. Myers. (WW) Detailed estimates of the wind fields existing in hurricanes are studied for future protection.

2814. Aerated Flow in Open Channels, by Progress Report, Task Committee on Air Entrainment in Open Channels. (HY) An investigation of the status of present (1961) knowledge of the phenomena of aerated flow in open channels is presented.

2815. Pneumatic Breakwaters to Protect Dredges, by James L. Green. (WW) Tests of pneumatic breakwaters and models to protect dredges from long oceans swells are presented.

2816. Forms of Bed Roughness in Alluvial Channels, by D. B. Simons and E. V. Richardson. (HY) The thesis that resistance to flow and sediment transport in alluvial channels are related to the form of bed roughness is analyzed, and the forms of bed roughness in alluvial channels are described.

2817. Estimating Potential Evapotranspiration, by W. Russell Hamon. (HY) Methods of computing potential evapotranspiration by analytical procedures based on the application of the turbulent transport and energy-balance concepts are analyzed.

2818. Fisheries Statistics in Evaluating Claims of Pollution, by Roger Tillefson. (SA) Statistics evaluating claims that waste discharges are responsible for declining or fluctuating fisheries resources are studied.

2819. Groins on the Shores of the Great Lakes, by Charles E. Lee. (WW) A summary of factual data on existing groins, changes in lake levels, and designs of groins are presented.

2820. Filtration Using Radioactive Algae, by Kenneth J. Ives. (SA) A new theory of filtration using radioactive algae is studied.

2821. Deep Water Wave Generations by Moving Wind Systems, by Basil W. Wilson. (WW) This paper concerns the mathematical justification of a procedure for forecasting wave heights and periods within traveling fetches of variable wind over deep water.

2822. Discussion of Proceedings Paper 2507, 2517, 2590, 2599, 2600, 2601, 2603, 2647, 2649, 2658, 2749. (WW) Per Bruun on 2601. F. Gerritsen on 2603. R. Robinson Rowe and Otto C. von Seggern on 2647. Blair T. Bower on 2649. J. W. B. Blackman on 2658. Roy F. Bessey on 2749. M. H. Marty and E. E. Chapus on 2507. Thomas J. Fratar, Alvin S. Goodman, and Austin E. Brant, Jr. on 2517. T. P. Anantram and Shri M. G. Hiranandani on 2590. Per Bruun on 2599. T. M. Dick on 2600.

2823. Roughness Spacing in Rigid Open Channels, by William W. Sayre and Maurice L. Albertson. (HY) Experiments are analyzed in which the effect of longitudinal and transverse spacing of roughness baffles on open-channel flow is determined.

2824. Dissolved Solids Removal from Waste Water by Algae, by Albert F. Bush, John D. Isherwood, and Shiva Rodgi. (SA) Methods of reclamation of waste water for eventual re-use are presented.

2825. Eddy Diffusion in Reservoirs and Pipeline, by Frank L. Parker. (HY) Tests of eddy diffusion in pipelines are analyzed and compared with Taylor's theoretical solution.

2826. Discussion of Proceedings Paper 2407, 2411, 2472, 2657, 2663, 2701. (SA) V. J. Calise and W. A. Homer on 2407. Clair N. Sawyer and Jay S. Grumbling on 2411. Donald J. O'Connor on 2472. James Girand on 2657. George Bugliarello on 2663. P. E. Seufer on 2701.

2827. Discussion of Proceedings Paper 2335, 2339, 2526, 2531, 2652, 2812. (HY) Steponas Kolupaila on 2335. M. B. McPherson on 2339. Donald F. Young on 2526. W. P. Simmons, Jr. on 2531. Donald VanSickle on 2652. J. F. Muir on 2812.

ORDER FORM FOR PROCEEDINGS

(For ASCE member use only)

To obtain complete Journals or reprints of the papers listed here, complete the mailing label below, write in the Journal name or paper numbers desired, cut it from this section, insert the label in an envelope, and mail to ASCE, 33 West 39th St., N.Y. 18, N.Y. Please make the mailing label legible—correct delivery is up to you.

Name .... Membership Grade ....

Address ....

City .... Zone .... State ....

Papers:

Journals (at a cost of $1.50 each):

PROFESSIONAL SERVICES

Listed alphabetically by areas, states, cities and names

EASTERN

JOHN J. MOZZOCHI and ASSOCIATES
Civil Engineers
Highways—Airports—Developments
Survey—Design—Inspection
217 Hebron Avenue, Glastonbury, Conn.
200 Dyer Street, Providence, R.I.

GREER-BOUTWELL
Architects-Engineers
Airports, Port Facilities
Public Works Projects
Industrial, Urban, Agricultural and Rural Development
129 South State Street Dover, Delaware

J. E. GREINER COMPANY
Consulting Engineer
General engineering services for heavy engineering construction projects, such as bridges, tunnels, highways, airports, dams, waterfront facilities, defense installations, and engineering management as applicable to projects financed by revenue bonds; general consultation, reports, design, supervision of construction, maintenance and operation.
1106 N. Charles St., Baltimore, Maryland

KNOERLE, GRAEF, BENDER & ASSOCIATES, INC.
Consulting Engineers
Highways, Bridges, Airports, Water-front Structures
210 N. Calvert St., Baltimore 2, Maryland
211 W. Wacker—Chicago 6—Illinois
Judge Building—Salt Lake City, Utah

WHITMAN, REQUARDT AND ASSOCIATES
Engineers
Sewerage and Water Systems, Highways Airports, Industrial and Power Plants and Other Structures
Reports • Designs • Specifications • Supervision
1304 St. Paul Street Baltimore 2, Md.

MADDOX AND HOPKINS
Engineers and Surveyors
Plane and Geodetic Surveys
Topographic Maps • Photogrammetry
Highways, Utilities, Structures
8506 Dixon Ave. Silver Spring, Md.

CLARKESON ENGINEERING COMPANY, INC.
Highways, Bridges, Structures, Airports, Dams, Traffic Surveys, Reports, Waterfront Facilities, Soils, Foundations, Sewerage, Construction Supervision
285 Columbus Avenue, Boston 16, Mass.

FAY, SPOFFORD & THORNDIKE, INC.
Engineers
Industrial Plants, Incinerators
Water Supply, Sewerage, Drainage
Bridges, Express Highways
Port and Terminal Work, Airports
Boston, Mass.

JACKSON & MORELAND, INC.
JACKSON & MORELAND INTERNATIONAL, INC.
Engineers and Consultants
Electrical • Mechanical • Structural
Design and Supervision of Construction for Utility, Industrial and Atomic Projects
Surveys • Appraisals • Reports
Technical Publications
Boston—Washington—New York

CHARLES A. MAGUIRE & ASSOCIATES
Engineers
Water Supply • Sewerage • Drainage
Highways • Bridges • Airports
Commercial and Industrial Buildings
Waterfront Facilities • Dams
Reports • Design • Supervision
Boston • Providence • Hartford

METCALF & EDDY
Engineers
Soils, Foundations, Waterworks, Sewage Works, Drainage, Irrigation, Flood Control, Refuse, Industrial Wastes, Airports, Highways, Military Projects, Industrial and Commercial Facilities
Statler Bldg., Boston 16, Massachusetts

The Thompson & Lichtner Co., Inc.
Civil and Industrial Engineers
Design, Supervision, Testing, Engineering and Production Studies, Special Structures, Tunnels, Airports, Highways, Foundations
Office and Laboratory • Brookline, Mass.

CRANDALL DRY DOCK ENGINEERS, INC.
Railway Dry Docks, Floating Dry Docks Basin Dry Docks, Shipyards, Port Facilities
Investigation, Reports, Design
238 Main St. Cambridge 42, Mass.

GOODKIND & O'DEA
Consulting Engineers
Design and Supervision
Foundations, Structures, Highways
610 Bloomfield Ave., Bloomfield, N. J.
1214 Dixwell Avenue, Hamden, Conn.
325 Spring Street, New York, New York
108 W. Lake St., Chicago 1, Illinois

JOSEPH S. WARD
Consulting Soil and Foundation Engineer
Site Investigation, Boring Supervision, Laboratory Soil Testing, Foundation and Pavement Analysis and Design, Construction Supervision, Engineering Reports and Consultation
91 Roseland Avenue, Caldwell, N. J.
Jefferson Building, Phila. 7, Pa.

EDWARDS AND KELCEY
Engineers and Consultants
TRAFFIC TRANSPORTATION PARKING EXPRESSWAYS AIRPORTS PUBLIC WORKS
Surveys—Reports—Design—Supervision
3 William Street, Newark 2, New Jersey
Boston, Salt Lake City, New York, Providence, Minneapolis

PORTER & O'BRIEN
O. J. Porter & Co.
Consulting Engineers
Airports • Highways • Dams • Structures
Foundations • Stabilization • Pavements
415 Frelinghuysen Ave., Newark 5, N. J.
4201 Sunset Blvd., Los Angeles 29, Cal.
1421 47th Ave., Sacramento 22, Cal.

LOUIS BERGER & ASSOCIATES
Consulting Engineers
Studies, Design, Supervision
Expressways, Airfields
Structures, Foundations
177 Oakwood Ave., Orange, N. J.
2nd and Locust Sts. Harrisburg, Penna.
200 S. Main Street Salt Lake City, Utah
8 rue de Neuchatel, Geneva, Switzerland
48 Baselerstrasse, Frankfurt, Germany

USE THIS PROFESSIONAL CARD DIRECTORY

Participation is restricted to consulting engineering firms operated or controlled by ASCE members.

AMMANN & WHITNEY
Consulting Engineers
Design and Construction Supervision of Bridges, Highways, Expressways, Buildings, Special Structures, Airport Facilities
111 Eighth Avenue, New York 11, N. Y.
724 E. Mason St., Milwaukee 2, Wisc.
1520 Connecticut Avenue, N.W. Washington 6, D. C.

BARSTOW & MULLIGAN
Engineers
Bridges, Highways, Parks
49 West 45th Street
New York 36, New York

BLAUVELT ENGINEERING CO.
Consulting Engineers
Highways, Bridges
Reports, City Planning
Municipal Engineering
New York, N. Y. Philadelphia, Pa.
Woodbury, N. J. Crystal Lake, Ill.

CLINTON BOGERT ENGINEERS
Consultants
Clinton L. Bogert, Ivan L. Bogert
Donald M. Ditmars, Robert A. Lincoln
Charles A. Manganaro, William Martin
Water & Sewage Works, Incinerators
Drainage, Flood Control
Highways and Bridges, Airfields
145 East 32nd Street, New York 16, N. Y.

BOWE, ALBERTSON & ASSOCIATES
Engineers
Water and Sewage Works
Industrial Wastes
Refuse Disposal
Valuations
Laboratory Service
75 West St., New York 6, N. Y.
1000 Farmington Ave. West Hartford 7, Conn.

BUCK, SEIFERT AND JOST
Consulting Engineers
Water and sewage works, industrial wastes disposal, hydraulic developments, dams, flood control. Chemical and biological laboratory.
112 East 19th Street, New York 3, N. Y.

FARKAS & BARRON
Consulting Engineers
Designs • Supervision • Reports • Highways
Expressways • Bridges • Housing • Public, Commercial and Industrial Buildings • Special Structures, Marine Structures • Airports
5 Beekman Street, New York 38, N. Y.
11 Commerce Street, Newark, N. J.
173 West Madison Street, Chicago, Illinois
7 Adelaide Street East, Toronto, Canada

GIBBS & HILL, INC.
Consulting Engineers
Water, Sewage & Industrial Waste Treatment Works—Roads, Bridges & Railroads—Conventional & Nuclear Power Generation—Electric Transmission & Distribution Systems—Industrial & Communication Facilities
Pennsylvania Station
New York 1, N. Y.

HARDESTY & HANOVER
Consulting Engineers
Bridges • Fixed & Movable
Highways • Expressways, Thruways
Special Structures
Design, Supervision, Inspection, Valuation
101 Park Avenue • New York 17, N. Y

FREDERIC R. HARRIS, INC.
Consulting Engineers
New York, N. Y.
Norwalk, Conn. New Orleans, La
Toronto, Canada The Hague, Holland

HAZEN AND SAWYER
Engineers
Richard Hazen, Alfred W. Sawyer
H. E. Hudson, Jr.
Water and Sewage Works
Industrial Waste Disposal
Drainage and Flood Control
360 Lexington Ave., New York 17, N. Y.

JOHN J. KASSNER & CO.
Consulting Engineers
Highways, Bridges, Structures • Sewerage and Drainage • Waterfront Construction Site Engineering and Recreational Facilities Reports, Designs, Contracts and Specifications, Supervision of Construction
6 Church Street New York 6, N. Y.

KING & GAVARIS
Consulting Engineers
ASSOCIATES: David Carsen, Dr. G. P. Tschebotarioff, Sidney Zecher
Bridges, Highways, Tunnels
Waterfront Structures, Reports
Investigations, Foundations
Design & Supervision of Construction
41 East 42nd Street, New York 17, N. Y.

LEGGETTE, BRASHEARS & GRAHAM
Consulting Ground Water Geologists
Water Supply, Salt Water Problems, Dewatering, Recharging, Investigations, Reports
551 Fifth Avenue, New York 17, N. Y.

MORAN, PROCTOR, MUESER & RUTLEDGE
Consulting Engineers
Foundations for Buildings, Bridges and Dams, Tunnels, Bulkheads, Marine Structures, Soil Studies and Tests, Reports, Design and Supervisor
415 Madison Ave., New York 17, N. Y.
Phone: EL 5-480

Is Your Card Among These?
It Should Be
Write Today For Rates

PROFESSIONAL SERVICES

Listed alphabetically by areas, states, cities and names

STEPHEN M. OLKO
Consulting Engineers
Reports and Designs
Soil Mechanics—Foundations
Marinas—Port Facilities
Structures—Highways—Airfields
50 E. 42 Street, New York 17, New York
OXford 7-1686

PARSONS BRINCKERHOFF, QUADE & DOUGLAS
Engineers
Bridges, Highways, Tunnels, Airports, Subways, Harbor Works, Dams, Canals, Traffic, Parking and Transportation Reports, Power, Industrial Buildings, Housing, Sewerage and Water Supply
165 Broadway New York 6, N. Y.

E. LIONEL PAVLO
Consulting Engineer
Design, Supervision, Reports
Bridges, Highways, Expressways
Marine Structures, Industrial Construction
Public Works, Airports
642 Fifth Avenue New York 19, N. Y.

MALCOLM PIRNIE ENGINEERS
Malcolm Pirnie Carl A. Arenander
Ernest W. Whitlock Malcolm Pirnie, Jr.
Robert D. Mitchell Alfred C. Leonard
MUNICIPAL AND INDUSTRIAL
Water Supply—Waste Treatment
Sewage and Waste Treatment
Drainage—Rates—Refuse Disposal
25 West 43rd Street, New York 36, N. Y.
3013 Horatio Street, Tampa 9, Florida

THE PITOMETER ASSOCIATES, INC.
Engineers
Water Waste Surveys
Trunk Main Surveys
Water Distribution Studies
Water Measurement and Special Hydraulic Investigations
New York, 50 Church St.

ALEXANDER POTTER ASSOCIATES
Consulting Engineers
Water Works Sewerage, Drainage, Refuse Incinerators, Industrial Wastes, City Planning
50 Church Street New York 7, N. Y.

PRAEGER • KAVANAGH
Engineers
126 East 38th St. New York 16, N. Y.

SEELYE STEVENSON VALUE & KNECHT
Consulting Engineers
Richard E. Dougherty, Consultant
Civil—Structural
Mechanical—Electrical
101 Park Avenue New York 17, N. Y.

SEVERUD • ELSTAD • KRUEGER • ASSOCIATES
Consulting Engineers
Structural Design • Supervision • Reports
Buildings • Airports • Special Structures
415 Lexington Ave., New York 17, N. Y.

SINGSTAD & BAILLIE
Consulting Engineers
Ole Singstad David G. Baillie, Jr.
Tunnels, Subways, Highways, Foundations, Parking Garages
Investigations, Reports, Design
Specifications, Supervision
24 State St. New York 4, N. Y.

FREDERICK SNARE CORPORATION
Engineers • Contractors
Harbor Works, Bridges, Power Plants
Dams, Docks and Foundations
233 Broadway, New York 7, N. Y.
Havana, Cuba Lima, Peru
Bogota, Colombia Caracas, Venezuela

STEINMAN, BOYNTON, GRONQUIST & LONDON
Consulting Engineers
Highways—Bridges—Structures
117 Liberty Street, New York 6, N. Y.

TIPPETTS • ABBETT • McCARTHY • STRATTON
Engineers and Architects
Ports, Harbors, Flood Control Irrigation
Power, Dams, Bridges, Tunnels
Highways, Railroads
Subways, Airports, Traffic, Foundations
Water Supply, Sewerage, Reports
Design, Supervision, Consultation
375 Park Avenue, New York 22, N. Y.

ARNOLD H. VOLLMER ASSOCIATES
Consulting Engineers
Highways, Parks, Bridges, Municipal Improvements, Public Works, Reports, Surveys, Contract Plans
25 West 45th Street
New York 36, New York
Telephone: Circle 7-6250

LAWRENCE S. WATERBURY
Consulting Engineer
26 Broadway
New York 4, N. Y.
Bowling Green 9-9298

ROMAN WOLCHUK
Consulting Engineer
Bridges—Structures
Design—Reports—Investigations
Stress Analysis
307 Fifth Avenue, New York 16, N. Y.
MUrrayhill 4-2390

LOCKWOOD, KESSLER & BARTLETT, INC.
Consulting Engineers
Civil Engineering Investigations and Reports, Design and Construction Supervision of Bridges, Highways, Pipelines, Expressways, Industrial Buildings, Sewerage, Airports and Municipal Improvements, General Site Engineering, Seismic Subsurface Investigation, Cadastral, Geodetic & Topographic Surveys, Photogrammetric Engineering & Mapping
One Aerial Way, Syosset, New York
Bogota, Colombia San Juan, P. R.

YULE, STICKLEN, JORDAN & McNEE
Engineers
Highways, Bridges, Airports
Design, Investigations, Reports
Supervision of Construction
Civil, Structural, Mechanical, Electrical
Cedar Cliff Drive 1225 Vine Street
Camp Hill, Pa. Philadelphia 7, Pa.
5564 North High St.
Columbus, Ohio

CAPITOL ENGINEERING CORPORATION
Consulting Civil Engineers
Dillsburg, Pennsylvania, U.S.A.

GANNETT FLEMING CORDDRY & CARPENTER, INC.
Engineers
Dams, Water Works, Sewage, Industrial Waste and Garbage Disposal • Highways Bridges and Airports, Traffic and Parking • Appraisals, Investigations, and Reports
HARRISBURG, PENNA.
Pittsburgh, Pa. Philadelphia, Pa.
Daytona Beach, Fla.

MODJESKI AND MASTERS
Consulting Engineers
Bridges, Highways, Structures
Special Foundations
Reports Inspections
Design
Supervision of Construction
900 Sixth St. New Orleans, La.
Harrisburg, Pa. Philadelphia, Pa.

AERO SERVICE CORPORATION
Integrated surveying and mapping services—including soils and sub-surface studies—for Highways, Water Supply, Dams, Airports, Municipal Developments, and other large engineering projects. Also associated electronic computing services.
210 E. Courtland St., Philadelphia 20, Pa.

ALBRIGHT & FRIEL, INC.
Consulting Engineers
Water, Sewage, Industrial Wastes and Incineration Problems, City Planning, Highways, Bridges and Airports, Dams, Flood Control, Industrial Buildings, Investigations, Reports, Appraisals and Rates
Three Penn Center Plaza, Phila. 2, Pa.

JUSTIN & COURTNEY
Consulting Engineers
Joel B. Justin Neville C. Courtney
Dams and Power Problems
Hydro Electric Developments
Foundations
121 S. Broad St. Philadelphia 7, Pa.

H. A. KULJIAN & COMPANY
Engineers and Architects
Power Plants (steam, hydro, diesel)
Industrial Buildings • Army & Navy Installations • Airports, Hangars
Water and Sewage Works
Design • Investigations • Reports • Surveys
1200 No. Broad St. Phila. 21, Pa.

HUNTING, LARSEN & DUNNELLS
Engineers
Industrial Plants • Warehouses
Commercial Buildings • Office Buildings
Laboratories • Steel and Reinforced
Concrete Design • Supervision
Reports
1150 Century Bldg., Pittsburgh 22, Pa.

MORRIS KNOWLES INC.
Engineers
Water Supply and Purification
Sewerage and Sewage Disposa
Valuations, Laboratory, City Planning
1312 Park Bldg., Pittsburgh 22, Pa.

PENNSYLVANIA DRILLING COMPANY
Subsurface Explorations. Grouting
Industrial Water Supply. Mineral Prospecting
Large Diameter Drilled Shafts
Reports
1205 Chartiers Ave. Pittsburgh 20, Pa.

SWINDELL-DRESSLER CORP.
Consulting Engineers
Industrial Plants—Waterworks—Sewer Systems—Highways—Dams—Bridges—Surveys—Reports—Design and Construction Supervision
Box 1888 • Pittsburgh 30, Pa.

DIVISION ENROLLMENT FORM

American Society of Civil Engineers

33 West 39th Street, New York 18, New York

☐ I am already enrolled
or
☐ I wish to be enrolled
in the ....
Division and receive automatically the Journal of that Division.

In addition, I wish to be enrolled in the
....
Division and receive automatically the Journal of that Division.

(Signature)

(Please print name) (Membership grade)

PLEASE PRINT MAILING ADDRESS ONLY

(Number and Street)

(City) (Zone) (State)

PROFESSIONAL SERVICES

Listed alphabetically by areas, states, cities and names

GILBERT ASSOCIATES, INC.
Engineers and Consultants
Surveys • Design • Supervision
Sanitary Engineering
Industrials and Utilities
Domestic and Foreign
525 Lancaster Avenue, Reading, Pa.
New York • Washington

MICHAEL BAKER, JR., INC.
Consulting Engineers, Planners & Surveyors
Airport, Highway & Bridge Design; Water & Sewerage; Municipal Engineering; Photo Mapping; City Planning, Urban Renewal & Redevelopment; Soils Lab; Survey Service
HOME OFFICE—ROCHESTER, PA.
Baker Building
Jackson, Miss., Northview Drive
Charleston, W. Va., 19 Dunbar Street
Harrisburg, Pa., 2799 N. Fourth Street

SPRAGUE & HENWOOD, INC.
Foundation Investigations • Soil Testing and Test Borings • Grout Hole Drilling and Pressure Grouting • Diamond Core Drilling
Scranton, Pa. — New York, N. Y.
Philadelphia, Pa. — Grand Junction, Colo.
Pittsburgh, Pa. — Nashville, Tenn.
Tucson, Ariz.
Buchans, Newfoundland

ALBRIGHT—DILL
Defense Consultants
Shelters—Blast Resistant Structures
Planning
Analyses
Special Studies
P. O. Box 675, State College, Pa.

ALSTER & ASSOCIATES, INC.
Engineers
Photogrammetric Engineering • Topographic Maps • Aerial Photography • Mosaics • Stock Pile Inventory • Plane & Geodetic Surveys • Land Acquisition Maps • Tellurometer and Geodimeter
6135 KANSAS AVENUE, N.E.
Washington 11, D. C. TA 9-1167

LASALLE HYDRAULIC LABORATORY
Theoretical And Experimental Studies
Hydroelectric development, Municipal hydraulics, Hydraulics of special problems, Maritime hydraulics, Hydraulics of rivers, Industrial hydraulics, Hydraulic measuring instruments and field measurements.
0250, St. Patrick Str. LaSalle (P.Q.) Can.

MID-WESTERN

ALVORD BURDICK & HOWSON
Consulting Engineers
Water Works, Sewerage, Water Purification, Sewage Treatment, Flood Relief, Power Generation, Drainage, Appraisals
20 North Wacker Drive, Chicago 6, Ill.

CONSOER, TOWNSEND & ASSOCIATES
Water Supply, Sewerage, Flood Control and Drainage, Bridges, Express Highways, Paving, Power Plants, Appraisals, Reports, Traffic Studies, Airports, Gas and Electric Transmission Lines
360 E. Grand Ave., Chicago 11, Illinois
9½ Indiana St., Greencastle, Ind.

DeLEUW, CATHER & COMPANY
Consulting Engineers
Public Transit — Subways
Traffic & Parking — Railroad Facilities
Expressways — Industrial Plants
Grade Separations — Municipal Works
Urban Renewal — Port Development
150 North Wacker Drive, Chicago 6
San Francisco — New York — Boston

THE ENGINEERS COLLABORATIVE
Consulting Engineers
Structural Drawings & Specifications
Advanced Structural Design & Analysis
Structural Model Analysis
Instrumented Load Tests & Analysis
Deep Excavation & Foundation Design
Seismic Measurement & Analysis
Noise Measurement & Analysis
Blast & Vibration Control
Petrographic & Geological Reports
116 South Michigan Ave., Chicago 3, Ill.

GREELEY AND HANSEN
Water Supply, Water Purification, Sewerage, Sewage Treatment, Refuse Disposal, Industrial Wastes
14 East Jackson Blvd., Chicago 4, Illinois

HARZA ENGINEERING COMPANY
Consulting Engineers
Hydroelectric Plants and Dams
Transmission Lines
Flood Control, Irrigation
River Basin Development
400 West Madison Street — Chicago 6

C. MARTIN RIEDEL
Consulting Engineer
Chemical Soil Solidification Engineering for Tunnels, Shafts, Mines, Foundations
Underground Structures
7650 S. Laflin St. — Chicago 20, Illinois
29-27 41st Ave., Long Island City 1, N.Y.

SOIL TESTING SERVICES, INC.
Consulting Engineers
John P. Gnaedinger — Clyde N. Baker, Jr.
Sub-Surface Investigations, Laboratory Testing, Inspection, Engineering Reports and Design of Foundations
1827 No. Harlem Ave., Chicago 35, Ill.
Kenilworth, N. J.—San Francisco, Calif.
Vedado Hana, Cuba

STANLEY ENGINEERING COMPANY
Consulting Engineers
Hershey Building — 208 S. LaSalle Street
Muscatine, Iowa — Chicago 4, Illinois
Hanna Building
Cleveland 15, Ohio

JENKINS, MERCHANT & NANKIVIL
Consulting Engineers
Municipal Improvements — Gas Systems
Highways & Airports — Water Systems
Power Development — Sewerage Systems
Traffic Surveys — Industrial Plants
Flood Control — Recreational Facilities
Investigations and Reports
801–805 East Miller St. — Springfield, Ill.

CLARK, DAILY & DIETZ
Consulting Engineers
James G. Clark — Jess C. Dietz
Eugene J. Daily — W. Don Painter
Expressways • Structures • Sanitary • Civil
211 N. Race, Urbana, Illinois
188 Jefferson, Memphis, Tennessee

NED L. ASHTON
Consulting Engineer
Aluminum and Steel Structures
Bridges and Paraboloidal Antennas
Swimming Pools and Foundations
Welded Design and Strengthening
820 Park Road — Iowa City, Iowa

WALLACE & HOLLAND
Consulting Engineers
Civil—Sanitary—Structural
401 N. Federal — Mason City, Iowa

SERVIS, VAN DOREN & HAZARD
Engineers-Architects
Investigations • Design • Supervision of Construction—Appraisals
Water • Sewage • Streets • Expressways
Highways • Bridges • Foundations • Airport
Flood Control • Drainage • Aerial Surveys
Site Planning • Urban Subdivisions
Industrial Facilities • Electrical • Mechanical
2910 Topeka Blvd. — Topeka, Kansas

JOHNSON & ANDERSON, Inc.
Engineers
Sewerage & Sewage Treatment
Water Supply & Distribution—Bridges
Highways—Municipal Engineering
Flood Control and Drainage
Home Office: Pontiac, Michigan
Branch Offices:
Warren, Mich., and Flint, Mich.

BLACK & VEATCH
Consulting Engineers
Water, Sewage, Electricity, Gas, Industry, Reports Design Supervision of Construction Investigations, Valuation and Rates
1500 Meadow Lake Parkway
Kansas City 14, Missouri

DAMES & MOORE
Consultants in Applied Earth Sciences
Soil Mechanics — Engineering Geology
Geophysics
Atlanta, Chicago, Honolulu, Houston
Los Angeles, New York, Portland
Salt Lake City, San Francisco
Seattle

BURNS & McDONNELL
Engineers-Architects-Consultants
4600 E. 63rd Street, Trafficway
Kansas City 41, Missouri

HOWARD, NEEDLES, TAMMEN & BERGENDOFF
Consulting Engineers
Bridges, Foundations, Airports
Administrative Services, Express
Highways, Traffic and Parking
1805 Grand Ave. — 99 Church St.
K. C. 8, Mo. — N. Y. 7, N. Y.
704 Standard Building
Cleveland 13, Ohio

SVERDRUP & PARCEL ENGINEERING CO.
Engineers • Architects
Bridges, Highways, Structures and Reports
Industrial and Power Plant Engineering
915 Olive Street, St. Louis 1, Mo.
417 Montgomery Street, San Francisco 4, Cal.

HAZELET & ERDAL
Consulting Engineers
Design, Supervision, Investigations, Reports
Fixed Bridges — Movable Bridges
Expressway Systems — Harbor Works & Dams
Dixie Terminal Bldg., Cincinnati 2, O.
Monadnock Block, Chicago 4, Ill.
Oding Bldg., Lansing 33, Mich.
Commerce Bldg., Louisville 2, Ky.

VOGT, IVERS & ASSOCIATES
Engineers-Architects
Highways—Structures—Expressways
Industrial Bldgs.—Harbor Facilities
Airports—Dams—Surveys
Transportation Studies—Reports
34 W. Sixth St., Cincinnati 2, O.
20 N. Wacker Dr., Chicago 6, Ill.

THE AUSTIN COMPANY
Design • Construction • Reports • Plant Location Surveys • Domestic and Foreign Work
3650 Euclid Avenue, Cleveland, Ohio
New York — Detroit — Oakland
Chicago — Houston — Seattle
Los Angeles

HAVENS AND EMERSON
A. A. Burger — H. H. Moseley
J. W. Avery — F. S. Palocsay
E. S. Ordway — G. H. Abplanalp
A. M. Mock — S. H. Sutton
Frank C. Tolles, Consultant
Consulting Engineers
Water, Sewerage, Garbage, Industrial Wastes, Valuation, Laboratories
Leader Bldg. — Woolworth Bldg.
Cleveland 14, O. — New York 7, N. Y.

THE OSBORN ENGINEERING COMPANY
Designing • Consulting
Industrial Plants — Office Buildings
Stadiums — Grand Stands — Field Houses
Bridges — Docks — Laboratories
7016 Euclid Ave. — Cleveland 3, Ohio

BENHAM ENGINEERING COMPANY
and Affiliates
Surveys Design & Supervision
of
Civil — Mechanical — Electrical
Sanitary — Structural
Engineering Projects
and
All Types of Building Construction
215 N.E. 23rd St., Okla. City 5, Okla.
430 Central Towers, Phoenix, Arizona

USE THIS PROFESSIONAL CARD DIRECTORY

Participation is restricted to consulting engineering firms operated or controlled by ASCE members.

SOUTHERN

BROWN ENGINEERING COMPANY, INC.
Architects—Engineers
Civil • Mechanical • Electrical • Industrial
Highway Design — Structural Design
Water Supply — Airports
Sewage Disposal — Industrial Plants
Land Development — Bridges
Railroads — Reports
Commercial and Industrial Buildings
P. O. Drawer 917, Huntsville Alabama

PROFESSIONAL SERVICES

Listed alphabetically by areas, states, cities and names

PALMER & BAKER, ENGINEERS, INC.

Consulting Engineers and Architects

Tunnels, Bridges, Highways, Airports, Industrial Buildings, Harbor Structures, Soils, Materials and Chemical Laboratories

Mobile, Ala. New Orleans, La.
Washington, D. C.

EUSTIS ENGINEERING COMPANY

Foundation and Soil Mechanics Investigations

Soil Borings Laboratory Tests
Foundation Analyses Reports

3635 Airline Highway
Metairie, Louisiana

BEDELL & NELSON ENGINEERS, INC.

Consulting Engineers—Architects

Airports, Buildings & Industrial Structures, City & Site Planning, Harbor Structures, Highways & Bridges, Industrial Plants, Municipal Improvements & Utilities, Reports, Estimates, Design, Supervision

1200 St. Charles Ave., New Orleans, La.

FROMHERZ ENGINEERS

Structural • Civil • Sanitary

Four Generations Since 1867
Water Supply, Sewerage, Structures, Drainage, Foundations, Industrial Waste Disposal, Investigations, Reports, Plants and Specifications, Supervision

816 Howard Avenue, New Orleans

ENGINEERS LABORATORIES, INC.

Foundation Engineers

Borings • Laboratory Tests • Analyses
Earthwork, Concrete & Asphalt Field Control
Engineering Reports & Recommendations

4171 Northview Drive
Jackson, Mississippi

WILLIAM F. GUYTON AND ASSOCIATES

Consulting Ground-Water Hydrologists

Underground Water Supplies
Investigations, Reports, Advice

307 W. 12th St., Austin 1, Texas
Phone: GR 7-7165

SPENCER J. BUCHANAN AND ASSOCIATES, INC.

Consulting Engineers

Soil Mechanics and Foundation Engineering, Earth Dams, Wharves, Airfields, Highways, Drainage, Structural Foundations; Reports, Design, and Field Supervision

310 Varisco Building, Bryan, Texas
Phone TAylor 2-3767

SOIL MECHANICS INCORPORATED

Foundation Exploration and Laboratory Testing Services

Site Investigations; Soil Borings; Field and Laboratory Testing of Soils, Concrete and Asphalt; Load Tests; Reports

310 Varisco Building, Bryan, Texas
Phone TAylor 2-3767
Houston—Phone MOhawk 7-1869

More and More Members of the Society are using this Service.
Is Your Card Here!

LOCKWOOD, ANDREWS & NEWNAM

Consulting Engineers

Industrial Plants, Harbors Public Works Roads, Airport, Structures, Earthworks Mechanical and Electrical
Reports • Design • Supervision
Surveys • Valuation

Corpus Christi • HOUSTON • Victoria
Texas

ETCO ENGINEERS AND ASSOCIATES FOUNDATION CONSULTANTS

Test Borings Laboratory Tests
Recommendations, Design and Supervision

2116 Canada Dry St., Houston 23, Texas
727 Main St., Baton Rouge, Louisiana
427 Carondelet St., New Orleans 12, La.

McCLELLAND ENGINEERS, INC.

6100 Hillcroft 201 Pine Street
HOUSTON, TEX. NEW ORLEANS, LA.

SOIL & FOUNDATIONS INVESTIGATIONS

WESTERN

ENGINEERS TESTING LABORATORIES, INC.

Warne-Sergent Engineers

Soil Mechanics and Foundation Engineers

2515 East Indian School Road
Phoenix, Arizona

ENGINEERING-SCIENCE, INC.

Design • Research • Planning

Water Supply Site Development
Sewerage Buildings
Flood Control Bridges

Municipal—Industrial

150 E. Foothill Blvd., Arcadia, Calif.
4144 Telegraph Ave., Oakland 9, Calif.

CLAY COLLEY

Consulting Engineer

Specializing in basic design of Material Handling and Dust Control Systems.
Reg. Eng. Calif., New Mex., Nev., Ore.

4032 McClung Drive
Los Angeles 8, Calif.

STETSON, STRAUSS & DRESSELHAUS, INC.

Civil and Consulting Engineers

Los Angeles Oceanside Porterville
INVESTIGATIONS • REPORTS •
DESIGNS • ESTIMATES

Water Supply, Drainage, Sewerage, Municipal Works, Foundations, Materials Testing, Surveying & Mapping.

Main Office:
215 W. 7th St., Los Angeles 14, Calif.

C. E. JACOB

Groundwater Consultant

Water Supply, Drainage, Dewatering, Subsidence, Recharging, Salt-Water Control, Statistical Hydrology, Digital and Analog Computation

P.O. Box 347 Northridge, Calif.
Cable JACOBWELL Los Angeles
DIckens 5-4990

Additional
Professional Cards on Pages 154, 155 and 156

KAISER ENGINEERS

Division of Henry J. Kaiser Company

Engineers • Contractors

Investigations • Reports • Valuations
Design • Construction

Crestview 1-2211

300 Lakeside Drive Oakland, Calif.

WOODWARD, CLYDE, SHERARD AND ASSOCIATES

Soil and Foundation Engineers

Oakland—San Diego—Denver—Omaha
Kansas City—St. Louis—Philadelphia
Montclair—New York

1150 28th Street, Oakland, California
680 Fifth Avenue, New York, N. Y.

INTERNATIONAL ENGINEERING COMPANY, INC.

Engineers

Investigations • Reports • Design
Procurement • Field Engineering
Domestic and Foreign

74 New Montgomery St.
San Francisco 5, California

JACOBS ASSOCIATES

Consulting Construction Engineers

Appraisal of Construction Costs • Methods Analysis • Field Engineering • Job Management • Review of Bidding Documents for Construction Economy • Engineering Geology • Plant and Equipment Design

503 Market Street
San Francisco 5, California

ROCKWIN ENGINEERS

Prestressed Concrete Consultants

Design	Bridges
Checking	Buildings
Investigations	Waterfront Structures
Inspections	Stadiums
Reports	Specialties
Construction Supervision	Prestressing Yard Facilities

13440 E. Imperial Highway, Santa Fe Springs, Calif. • UNiversity 8-1761

SHANNON AND WILSON

Soil Mechanics and Foundation Engineers

1105 North 38th Street
Seattle 3, Washington

FOREIGN

SACMAG

Engineers & Architects

Ave. de la Independencia 774

Ensanche del Vedado, Habana, Cuba
San Juan, P. R. Mexico City Salvador

GORDON M. ROSE

Consulting Civil Engineers

ENGLAND

Public Buildings, Industrial Plants, Structures, Foundations, Heating, Ventilating, Mechanical, Electrical.
Investigation • Valuations • Reports
Design • Supervision

82 Victoria Street, London, S.W. 1
Telephone: Tate Gallery 0595

AMMANN & WHITNEY

Consulting Engineers

111 Eighth Avenue, New York 11, N. Y.

Buildings, Industrial Plants, Airport Facilities
Bridges, Highways, Special Structures

29 Rue de Pyramides, Paris, France
32 Patission Street, Athens, Greece
P.O. Box 1423, Tehran, Iran
P.O. Box 1498, Addis Ababa, Ethiopia

GREER-BOUTWELL

Architects-Engineers

Airports, Port Facilities
Public Works Projects
Industrial, Urban, Agricultural and Rural Development

15 Rue de la Cite, Geneva, Switzerland
26 Avenue Trudaine, Paris 9, France
Avenue Bahar and Shahreza, Tehran, Iran
P.O. Box 4191, Karachi, Pakistan

USE THIS PROFESSIONAL CARD DIRECTORY

Participation is restricted to members or firms where one or more of the principals are members of the American Society of Civil Engineers

Your Card Should be Among Them • Write Today for Rates

Index to Advertisers

Advertising Manager

James T. Norton

Advertising Production Manager

Jerry Nussbaum

33 West 39th Street, New York 18, N. Y.

Representatives

EASTERN

- Robert S. Cypher
  33 West 39th Street, New York 18, N. Y.

SOUTHEASTERN

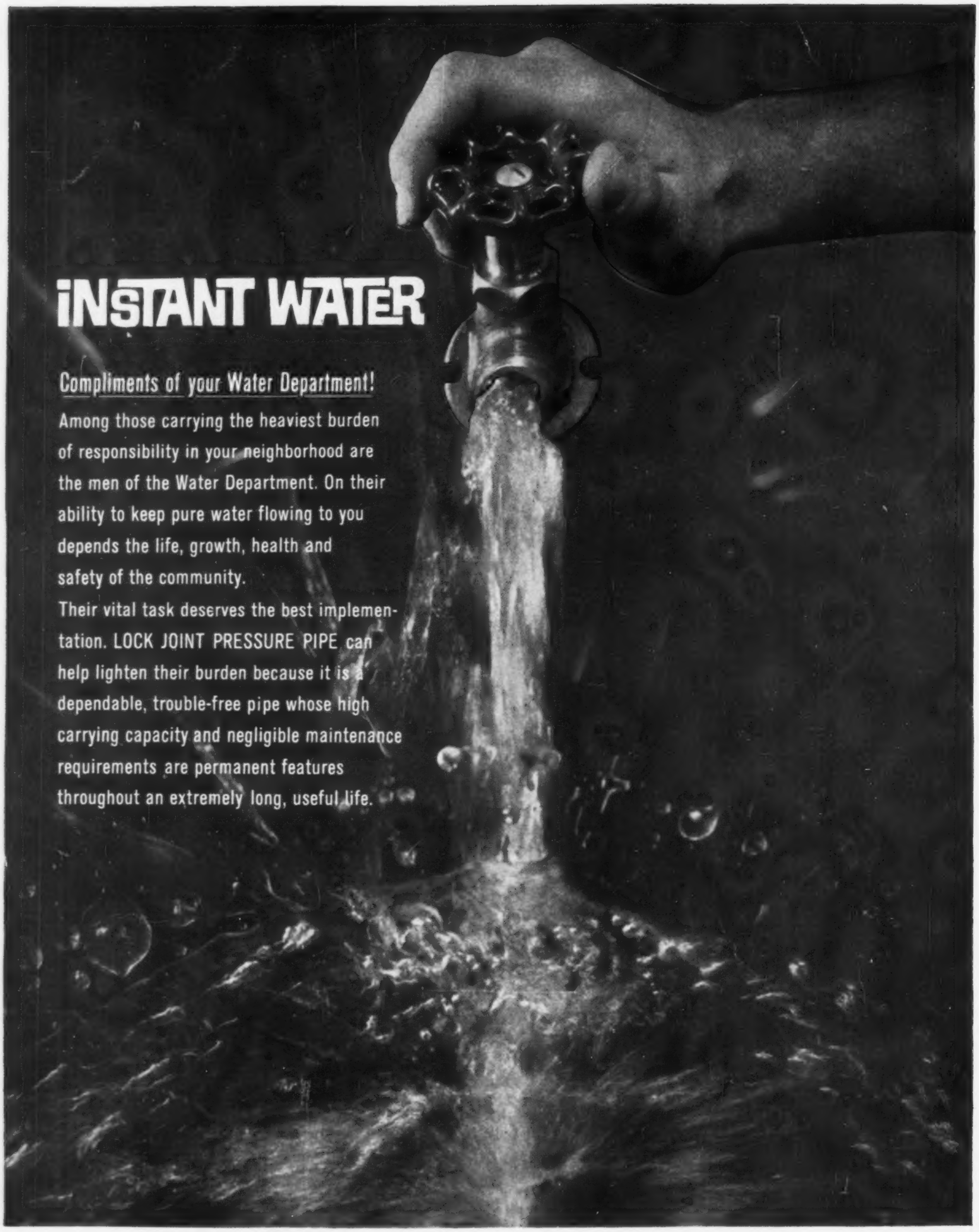
- Fred W. Smith
  1201 Forest View Lane—Vesthaven
  Birmingham 9, Ala.

MID-WESTERN

- Richard K. Holmstrom
  Suite 812, 29 East Madison St., Chicago 2, Ill.
- Frank X. Nugent
  Suite 1313, 75 Public Square, Cleveland 13, Ohio

WESTERN

- McDonald-Thompson, Inc.
  625 Market St., San Francisco 5, Calif.
  3727 West Sixth St., Los Angeles 5, Calif.
  National Bldg., 1008 Western Ave., Seattle 4, Wash.
  2035 S.W. 58th Avenue, Portland 1, Oregon
  3217 Montrose Boulevard, Houston 6, Texas
  620 Sherman Street, Denver 3, Colorado
  2727 Oak Lawn Avenue, Dallas 19, Texas


INSTANT WATER
Compliments of your Water Department!
Among those carrying the heaviest burden of responsibility in your neighborhood are the men of the Water Department. On their ability to keep pure water flowing to you depends the life, growth, health and safety of the community.
Their vital task deserves the best implementation. LOCK JOINT PRESSURE PIPE can help lighten their burden because it is a dependable, trouble-free pipe whose high carrying capacity and negligible maintenance requirements are permanent features throughout an extremely long, useful life.